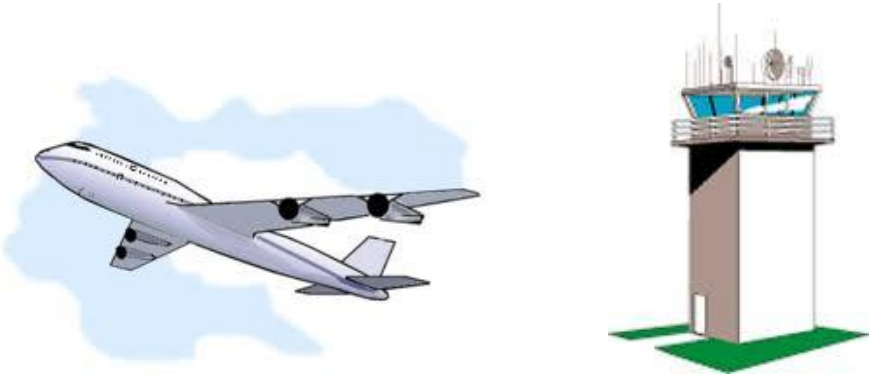
A study of problems Latvian and Norwegian airline transport pilots face when perceiving speech of their native-speaking colleagues



by

Olga Jurcenko

A Thesis presented to

The Department of Literature, Area Studies and European Languages

The University of Oslo

in partial fulfillment of the requirements

for the Master Degree

Autumn term 2012

Acknowledgements

I am deeply grateful to my main supervisor Hildegunn Dirdal for professional and personal support throughout the entire process, outstanding patience and enthusiasm. I would also like to thank my second supervisor Gjertrud F. Stenbrenden who introduced me to the secrets of phonetics, helped me with valuable advice, encouraged me and provided me with constructive criticism. Special thanks to both of my supervisors for supporting me during the design and recording of the test, and for answering thousands of my questions at any time of the day.

My study would not have been possible without the support of Ērika Neimane, the Head of the Air Traffic Management Section of the Latvian Civil Aviation Agency, and Knut Backer, the Vice President of the Norwegian Airline Pilots' Association, who gave me the unique opportunity to conduct the practical part of my study in the Latvian Civil Aviation Agency and in the Norwegian Airline Pilots' Association's premises, and helped with the organizational matters.

Furthermore, I would like to thank my friends and assistants Lelde Zena and Jeanne Le Lamer for not only adjusting equipment, making copies and providing drinks, but also for trust and emotional support.

Without the participation of the Latvian and Norwegian pilots this study would not have been possible. Particular thanks to all the pilots who took part in this study for sharing their experience and devoting time and effort in order to shed light on the challenges of aeronautical communication.

Many thanks go to my family and friends for their continuous love, care and support throughout the writing process.

I am thankful to all the people who cultivated my love for aviation.

Finally, I thank the University of Oslo for offering me an opportunity to continue my studies at master's level, for providing me with high-quality education and for fostering my interest for research and science.

Table of Contents

List of figures

Summary

While working for airline companies in Latvia and in Norway, I noticed that English plays an important role in the aviation environment, as it is the only language used in international aeronautical communication. However, not enough attention is paid to English language training for pilots: the special needs of the learners are often neglected, and the pilots' background knowledge and L1 are not taken into account.

The purpose of this study was to find out whether Latvian and Norwegian pilots have different language problems which mainly depend on the influence of their mother tongues, or whether the problems are the same and depend on universal processes rather than language transfer. I wanted to find out whether those who develop language teaching materials should design the materials for Latvians and Norwegians separately (in case they have different problems) or if both groups can use the same "global textbooks" (in case they face the same problems).

In the theoretical part of this study I compared the Latvian, Norwegian and RP vowel systems in order to find similarities and differences in the systems of these three languages. I based my contrastive analysis mainly on the descriptions of phonemes provided by Bird (2005), Grigorjevs (2008), Kaurāte *et al*. (1985), Laua (1997), Nilsen (2010), Popperwell (2010), Vanvik (1975, 1983).

Then I designed a questionnaire and test based on the findings of the contrastive analysis. I gave it to 48 Norwegian and 30 Latvian pilots, whose task was to listen to RP vowel phonemes (sometimes substituted by the phonemes of their L1s) in connected speech and in isolated words, and to choose the phoneme they heard out of several possible options.

The results indicate that the pilots tend to assimilate their native phonemes to the RP phonemes; however, there are also other processes apart from language transfer that influence the pilots' perception. The findings also show that connected speech creates more problems for both groups, and that the participants' perception problems sometimes affect the ability to distinguish between English phonemes, which could cause misunderstandings. The Latvians demonstrated worse results for all the three parts of the test. On the basis of the findings of this study, I suggest having different language teaching programmes for Latvians and Norwegians.

1 Introduction

Today more and more people are using air transport as a means of conveyance. It is one of the fastest, safest and most convenient ways of traveling long distances. The aviation industry has changed dramatically over the last decades. Aircraft manufacturing has seen a rapid development. Nowadays human mistakes are more frequent in aircraft catastrophes than mechanical failures (Dhillon, 2007: 5). As the skies have become more crowded, communication between pilots and air traffic controllers has become more critical. The mistakes they make are often connected with insufficient knowledge of English, the only internationally accepted language in aeronautical communications. According to the International Civil Aviation Organization's review of 28000 incident/accident reports, over 70% of aviation problems are caused by language mistakes (Mayflower College, 2012a).

For instance, the aircraft catastrophe with the largest number of human deaths in the history of aviation (583 people) happened in Tenerife, Canary Islands, in 1977. One of the reasons was a misunderstanding between the air traffic controller and the aircraft. The American crew found it impossible to communicate with the Spanish controller due to his poor knowledge of English (Roitsch *et al.*, 1978: 11). Unfortunately, this is not the only example. Cookson (2009: 22.1–22.2) mentioned seven accidents which were at least partly caused by language factors. These accidents occurred between 1976 and 2001, and resulted in the deaths of 1460 people.

Even though the situation has improved in tems of fatal accidents in the last decade, incomprehension and misunderstandings still cause problems. Neimane, the Head of the Air Traffic Management Section of the Latvian Civil Aviation Agency, (2012: personal communication) gives an illustrative example. In 2012, there was an incident involving an SAS crew and passengers, who were travelling to Eastern Europe. One of the passengers on board the aircraft was sick. The pilots were trying to tell the air traffic controllers that they needed an ambulance to be kept ready near the runway. The air traffic controllers did not understand what the pilots were talking about, and instead continuously repeated the altitude they were flying at. As a result, the poor passenger did not get immediate help.

The safety of thousands of people depends on how successful the communication between air traffic personnel is. This communication has received renewed attention, and much has been done to strengthen provisions for language proficiency in recent years. The standards of

the International Civil Aviation Organization now demand that all pilots flying internationally and all air traffic controllers providing services to international flights must know not only Standard Phraseology (i.e. standard commands used on a daily basis), but must also speak plain language (i.e. general English used in non-routine situations focused on aviation-specific topics) with the focus on international intelligibility rather than a specific variety (ICAO, Manual on the Implementation of ICAO Language Proficiency Requirements, Doc 9835 AN/453, 2004: 2.4). It is not easy to follow this standard, and there are still many pilots and air traffic controllers whose knowledge of English does not meet international demands. This pertains especially to countries where English is not taught thoroughly at school. While there are single international standars, there is no single examination or any other assessment tool which would control how the new requirements are observed, and no single qualification course which would instruct language specialists on how the new guidance materials are to be used.

However, it is a debatable question whether the same language training programmes would fit every pilot and air traffic controller, not taking into account their personal needs and the influence of their L1s, which is widely discussed in Second Language Acquisition studies. Is language learning guided mainly by universal processes, and do we have reason to assume that "one size fits all", that we can use globalized teaching materials, or should teaching materials be designed for every country separately taking into account the specific problems of the target group and the features of the learners' L1s?

The present study attempts to answer this question by testing how a group of 48 Norwegian and 30 Latvian airline transport pilots perceive the speech of native speakers of English. I test whether each group of pilots has specific language perception problems, or whether the problems are the same and depend mainly on universal processes rather than language transfer. I also investigate whether the perception problems only have to do with the specific nuances of sounds, or whether they also affect the ability to distinguish between English phonemes, which could cause misunderstandings in a real-life situation. Further I look at whether connected speech creates additional problems for the participants.

I hypothesized that Norwegians might make fewer mistakes than Latvians, as English is not as widely used in Latvia as it is in Norway. In addition, the two languages belong to different language families, and Norwegian is more closely related to English than Latvian is. By comparing these two groups I wanted to see not only whether they are making different mistakes

and how these mistakes differ, but also whether Norwegians would demonstrate better results than Latvians, and to what extent.

In this study I chose to focus on pilots, but not air traffic controllers, for three reasons. Firstly, I based my choice on a previous study by Howard (2008: 370), who examined problematic communication in pilot–air traffic controller interaction. He collected more than 15 hours of pilot–air traffic controller dialogue with 1799 turns of talk, and revealed that pilots had more communication problems than their colleagues (*ibid*.). Secondly, those who want to become air traffic controllers must pass a compulsory FEAST test (the First European Air Traffic Controller Selection Test) in order to have the right to work under European skies (although this pertains only to the members of Eurocontrol, and only starting in the year 2004). The FEAST contains an English section which tests listening and comprehension at a high level. Pilots do not have a standardized language examination so far. Thirdly, pilots are involved in all phases of communication, while each air traffic controller is responsible only for one particular phase – departure and arrival, approach, or midair (Kim and Elder, 2009: 23.3).

I decided to concentrate only on listening, but not on speaking. I was guided by the fact that air traffic controllers are the ones who usually initiate transmittion and present new information, whereas pilots are mostly engaged in accepting information (Morrow *et al*., 1994: 245).

Due to time and space limitations, I chose to study only the perception of vowels, and not consonants. I turned to previous research on speech intelligibility when only consonants or only vowels were replaced by noise (Kewley-Port *et al*., 2007: 2365–2375; Owren and Cardillo, 2006: 1727–1739; Stilp and Kluender, 2010: 12387–12392), compared Latvian and English consonants and vowels, and Norwegian and English consonants and vowels and studied the phonetics presented in textbooks for pilots. I came to the conclusion that both consonants and vowels are worth researching as they are equally, or almost equally, important for the perception of speech in aeronautical communication.

The thesis will start with a general description of influences on speech perception, to show that speech perception is a complex phenomenon and the present study covers only a small part of it. I will proceed with a description of English vowel phonemes and the vowel phonemes of the native languages of the pilots, which might have an influence on their perception of the target language speech. Then I will describe the design and purpose of the test, give some

information about the administration of the test and about the participants, present and analyse the results of the test, and draw conclusions. Finally, I will say a few words about the application of the findings and make suggestions for further research.

2 Influences on speech perception

The present thesis studies the problems of the auditory perception of speech. The auditory perception of speech is "a process of interpreting the instructions imprinted on the acoustic wave by the speaker over a time span" (Sanders, 1977: 98), or, as stated by Berry (1969: 59), the auditory perception of speech "deals mainly with the temporal management of information from the input". The auditory perception of speech is often defined as *hearing* or *listening*, which are not completely the same. *Listening* is considered to be a far more complex process than *hearing*, as listening involves attention while hearing does not (*Oxford English Dictionary*, 2011). Some scholars discuss speech perception rather in relation to the process of *hearing* than *listening*, e.g. Moore (1997), some prefer the latter, e.g. Handel (1989). In this study I will refer to the auditory perception of speech as being a result of listening, as it requires a deliberate attempt on the part of the pilot and does involve attention.

Traditionally, the description of the auditory system starts with the representation and anatomical study of the organ of hearing – the ear. The function of the auditory system, i.e. the transmission and analysis of acoustic information, is more or less universal. A short overview of the transmission of acoustic information is as follows:

> The ear has three main parts – the outer ear, the middle ear and the inner ear. The outer ear is composed of the pinna and the auditory canal or meatus. The pinna modifies the incoming sound. Sound travels down the meatus and causes the eardrum to vibrate. These vibrations are transmitted through the middle ear by three small bones, the ossicles, to a membrane-covered opening in the bony wall of the spiral-shaped structure of the inner ear – the cochlea. This opening is called the oval window. When the oval window is set in motion by an incoming sound the basilar membrane (BM) moves. Near the BM there is the tectorial membrane (TM), which has a gelatinous structure. Between the BM and the TM are hair cells. The BM moves up and down, a shearing motion is created between the BM and the TM. The inner hair cells act to transduce mechanical movements into neural activity. (Moore, 1997: 17–29)

In this chapter I will examine three factors which have an influence on speech perception, but which may vary according to individual differences – hemispheric asymmetry, selective attention and L1 influence. My study deals mainly with L1 influence, but I decided to include a discussion of hemispheric asymmetry and selective attention in order to give a more general overview of speech perception processes, and to show that the phonetics of the target and the native

languages of the listeners is not the only influence on speech perception. I thus attempt to introduce some other aspects of the research problem and show that it is many-sided.

2.1 The hemispheric asymmetry of speech perception

Research has shown that the two halves of the brain are not symmetrical. There are differences in the structure, function and capacity of information processing between the right and left cerebral hemispheres.

Anatomical differences involve a distinction in shape between the two hemispheres and in specific brain areas within each hemisphere – e.g. the protrusion of the right frontal pole and the protrusion of the left occipital pole, the larger volume of Broca's area in the left hemisphere and the deeper central sulcus on the left side of the brain, etc. (Sequeira, 2008: 16; Zilles *et al*., 1996: 596–602).

The British experimental psychologist Broadbent, a member of the Royal Air Force, devoted much time to observe communication difficulties between airline transport pilots (henceforth *pilots*) and air traffic controllers (henceforth *controllers*) and came to the conclusion that communication difficulties arose mainly due to inefficient processes of attention, perception and memory, rather than failures of technical equipment (Sequeira, 2008: 24). In 1954, Broadbent introduced the dichotic listening procedure to investigate what happens when someone deals with several sound signals at the same time (*ibid*.). The dichotic technique was further developed by other neurologists, e.g. Kimura (1961), Studdert-Kennedy and Shankweiler (1970), Geffen and Quinn (1984). In dichotic listening, different sounds are presented simultaneously to the right and the left ear to participants using headphones. The experiments revealed the same results: the right-ear superiority in the perception of verbal stimuli (this tendency is commonly referred to as *the right-ear advantage*) and the left-ear superiority in the perception of non-verbal stimuli (*the left-ear advantage*) in approximately 95 percent of cases (Ryalls, 1996: 86; Torkildsen, 2002: 23).

> The explanation for the right-ear superiority on the digits test, then, was that the right ear had better connections with the left hemisphere than did the left ear, and since the left hemisphere was the one in which speech sound were presumably analysed, the right-ear sounds had the advantage of having better access to these speech centres. (Kimura, 1967: 164)

Left-handed participants and ambidexters[1] appeared to have less pronounced hemispheric differences than right-handed persons, and in approximately half of all cases these differences were the opposite (Mescerjakov and Zincenko, 2004).

The result of dichotic listening indicates the greater involvement of the left brain hemisphere in speech processing, though it concerns only right-handed persons, who constitute the major part of the total world population. As there are usually more fibres (or larger connections) between the ear and the opposite hemisphere (Kimura, 1967: 164; Ryalls, 1996: 86), verbal input arriving at the right ear is perceived more accurately than input arriving at the left ear by the majority of listeners. However, the importance of the dichotic effect is not to be exaggerated. The effect of dichotic listening occurs only under special conditions, i.e. the acoustic signals must be delivered to each ear simultaneously, and they must be of similar intensity and length (*ibid*.: 88).

Functional differences in the two sides of the brain have been observed by neurologists for more than a century. Before the mid-twentieth century, neurologists (Broca, 1824–1880; Wernicke, 1848–1904; Vygotsky, 1896–1934) argued that speech is controlled only by the left hemisphere of the brain (Danesi, 2003: 32–34). Such results were obtained mainly by observing patients with brain injuries restricted to one part of the brain. While researching patients suffering from strokes, a German neuroscientist, Wernicke, identified an area of the brain responsible for speech perception: the upper posterior part of the temporal lobe (Wernicke's area) in the dominant cerebral hemisphere, usually the left hemisphere of the brain (Ellis, 2008: 735; Mehta, 2011: 378).

During the 1950s, "split-brain" studies conducted by the American psychologist Sperry (1913–1994) provided evidence that the right brain hemisphere is also linked to language. Sperry discovered that the right brain hemisphere is responsible for intonation, metaphorical and emotional meaning, non-verbal memory, intuitive and spatial reasoning, concretizing and associating between things, synthesis and multiple thinking (Danesi, 2003: 35). Comparatively recent brain studies agree with Sperry's findings. According to Gernsbacher and Kaschak (2003: 107–108), some of the functions of the left hemisphere are the auditory processing of sounds, phonological and semantic processing, syntactic processing, discourse processing, production of

[1] Ambidexter – 'a person who uses both hands with equal ease' (*Longman Dictionary of Contemporary English*, 2009).

verbal and non-verbal motor responses to tasks, maintenance of phonological representations, production of subvocalizations, etc. The scholars maintain that the right hemisphere deals with the detection of emotional content in speech and the processing of abstract words, and is also responsible for sentence processing and discourse processing (Gernsbacher and Kaschak, 2003: 107–108).

Differences in the functional hemispheric asymmetry of speech perception have been found to exist not only between right-handed persons, left-handed persons and ambidexters, but also between monolingual and bilingual speakers. The research on hemispheric differentiation in monolinguals and bilinguals suggests that monolinguals in most cases are more left-hemisphere dominant than bilinguals (Albert and Obler, 1978: 254; Hagen, 2008: 46). Some studies of aphasia provide evidence of anatomical differences between the first language (henceforth *L1*) and second language (henceforth *L2*), and show that in cases where the left temporal lobe is damaged, the bilingual has difficulties with the L1, but not with the L2 (Gomez-Tortosa *et al.*, 1995: 320–325; Price *et al.*, 1999: 2230–2231). However, not all research supports such findings.

On the one hand, the standard aeronautical phraseology might more likely be processed through the left region of the brain, as it is responsible for speech perception in general. The standard aeronautical phraseology is rather simple and does not contain complex sentences which would require more discourse-processing skills, which are related also to the right brain hemisphere. In this case the right region of the brain might help to process plain language used in emergency situations, where a multiple thinking ability and processing of more comprehensive data are required. On the other hand, such an assumption would be too categorical, not taking into account the multiple nuances discussed above, such as the differences between left-handed persons, ambidexters and right-handed persons, the conditions of the delivery of the acoustic signals, the differences between monolinguals and bilinguals, and many other factors not included in this section, e.g. mental diseases in the interlocutors. It follows that the individual situation in each person must be taken into consideration in order to achieve more reliable results. Still, even in this case, the conclusions will not be definitive as we do not know all the details regarding the hemispheric asymmetry of speech perception yet, and it is difficult to say which specific regions of the brain are activated by a particular task.

As for the present study, the difference between the right brain hemisphere and the left brain hemisphere is not so important, as I will be dealing with one acoustic signal at a time and present it to both ears.

2.2 Selective attention

For the purpose of this study, I have chosen to define the auditory perception of speech as *listening* rather than *hearing*, as listening involves attention. Attention is a process which defies simple definition. According to Suchert (2004: 144), attention is "a process in which biological mechanisms interact when goal-directed behaviours and stimulus-driven responses converge in action". Suchert describes attention as a series of processes of evaluation, action and reaction (*ibid*.). Robinson (2003: 631) defines attention as "the process that encodes language input, keeps it active in working and short-term memory, and retrieves it from long-term memory". In this section I will concentrate only on selective attention. Research into selective attention addresses many issues such as the following: to what extent can the listener control the direction of attention, or be able to give rise to some change to the stimulus environment in order to separate important information from background interferences or any other disturbing noises and factors? When and how does selection happen? Why does it happen?

Wickens, Gordon and Liu (1997: 147) describe three uses of the concept of attention in their generic model of human information processing: (1) auditory and visual information intake and processing, (2) central control and decision-making functions, and (3) response execution and monitoring via sustained attention. Their model shows that information is selected for perceptual encoding by attentional mechanisms. Some scholars (Broadbent, 1958; Shannon and Weaver, 1949, cited in Yudofsky and Hales, 2008: 406) assume that humans have a limited capacity for attention, and that auditory and visual information must be channelled for further processing. Selection is considered to be a consequence of this limited attentional capacity (Neumann, 1996: 395). Further, Broadbent's dichotic listening tasks, in which messages are presented simultaneously to the right and left ear, indicated that information can be processed in parallel (Robinson, 2003: 634; Sequeira, 2008: 24). Selection theories which appeared after this discovery claim that selection takes place in working memory after stimuli have been fully analysed (Allport, 1987, cited in Robinson, 2003: 635).

According to some recent studies (Allport, 1987, 1993; Neumann, 1987, 1996, cited in Schmidt and Lee, 2011: 102), selection happens in order to satisfy the requirement for coherent speech and action, as actions are responses to task demands. Selection is a means of action control, but not a response to capacity limitations.

Attention may or may not be conscious. Conscious attention can take place "if the neurons that are innately receptive to stimulus properties are activated by some change to the stimulus environment" (Ellis, 2008: 756). Unconscious attention involves activation of neurons in the dorsolateral prefrontal cortex when an object is noticed without physically orienting to it (*ibid*.).

Attention can be controlled. Attention control is constrained to a determination to engage, disengage and shift attention between tasks (Gopher, 1992: 279). Addressing this issue, attention is viewed as a capacity, but capacity, unfortunately, is limited, as assumed by much Second Language Acquisition research (Robinson, 2003: 645). Complex tasks demand more attention than simpler tasks; performing several tasks simultaneously demands more attention than performing one. Regarding language processing, linguists make a distinction between controlled and automatic language processing. Controlled language processing is viewed as more attention-demanding and involves a greater mental load (DeKeyser, 2003 and Ellis, 1994, cited in Robinson, 2003: 642–643). Therefore, it is worth automatizing language processes in order to reduce decision space and hence minimize the mental load.

2.3 Influence of the L1 on L2 perception

Potential influence of the learner's L1 on the L2 has been frequently discussed by linguists over an extensive time period (e.g. Best *et al*., 2003; Jarvis and Pavlenko, 2008; Lado, 1957; McAllister, Flege and Piske, 2002; Odlin, 1989; Ringbom, 1987, 2007; Trubeckoj, 1939, 1958). In the 1950s, Lado posited the Contrastive Analysis Hypothesis, which suggested that "the student who comes into contact with a foreign language will find some features of it quite easy and others extremely difficult. Those elements that are similar to his native language will be simple for him, and those elements that are different will be difficult" (1957: 2). This view was applied not only to speech production, but also to speech perception. Trubeckoj (1939, 1958, cited in Major, 2001: 31) shared the same ideas and argued that "L2 perception is 'filtered' through the 'sieve' of the L1". However, nowadays the Contrastive Analysis Hypothesis seems

too simplistic, and more complex theories of transfer are employed (see further description at the end of this section).

The findings of comparatively new research indicate that the listener's L1 has an impact on L2 perception. For instance, McAllister, Flege and Piske (2002: 229–258) examined whether the L1 would influence the perception of the L2 long–short vowel contrasts. Twenty native speakers of English, Spanish and Estonian were asked to decide whether each of the presented Swedish vowels was produced correctly. The results revealed that Estonians benefited from the presence of long vowels in their L1s; English and Spanish speakers did better with the Swedish long–short contrasts when vowels of the same length appeared in their L1s; all the participants had obvious difficulties when the long or short vowels were not used in their L1s (*ibid*.: 256).

Another study on non-native speech discrimination, conducted by Best, Halle, Bohn and Faber (2003: 2889), showed that Japanese listeners who were inexperienced with English had difficulty categorizing and discriminating the /r/–/l/ phonemes, but not /w/–/r/ and /w/–/j/ phonemes. The reason was that Japanese does not have the /r/–/l/ phonological contrast, but does have /r/ and the /w/–/r/ and /w/–/j/ contrasts.

The findings of another study by the same scholars (*ibid*.: 2891) were consistent with the Perceptual Assimilation Model which hypothesizes that "listeners assimilate non-native phones to the native phonemes that are perceived to be the most similar articulatorily". Discrimination of an L2 contrast depends on whether they are assimilated to the same or different L1 phonemes, and on how well they fit the native categories (*ibid*.). The task of 16 English and Danish, and of 24 French, listeners was to discriminate between recorded Norwegian vowel contrasts, namely /i/–/y/, /y/–/ʉ/, /ʉ/–/u/ and /y/–/u/. It was found that "both phonological and phonetic properties of the native language effected strong, systematic differences in non-native vowel perception by listeners of varying L1s" (*ibid*.: 2892).

However, not all linguists consider language transfer to play an important role in L2 acquisition, production and perception. For example, Dulay and Burt (1974: 37–53) provide strong support for the existence of universal strategies which are used in both L1 and L2 processing. Although there might be a mixture of universal strategies and transfer, the results of their study provide a strong indication that it is the L2 system, rather than the L1 system, that guides the L2 acquisition process. Felix (1980: 107) also came to the conclusion that the

learner's L1 plays an insignificant role in L2 processing, after having examined three syntactic structures in English-speaking children's acquisition of L2 German.

A number of recent studies (Cenoz, 2001; Eckman, 2004; Jarvis, 2000; Kellerman, 1977, 1995; Ringbom, 1978, 2001, 2007; Wode, 1976, cited in Jarvis and Pavlenko, 2008: 176) emphasize crosslinguistic influence on language learning. These studies suggest that different language systems in the mind interact, and in most areas of language use the extent of transfer is highest when the source and recipient languages are perceived to be very similar by the L2 user. These studies do not, however, deny that transfer does occur also between languages that are quite different, though the extent of transfer in this case is lower. Ringbom (2007: 1) stresses that learning is based on prior knowledge, and that the learner's L1 can facilitate L2 learning if the languages are closely related: "if you learn a language closely related to your L1, prior knowledge will be consistently useful, but if the languages are very distant, not much prior knowledge is relevant".

In early studies, transfer was viewed in isolation. Nowadays most linguists agree that the role of the L1 cannot easily be separated from other factors that influence L2 development. For instance, linguists consider that L1 transfer interacts with Universal Grammar, sociolinguistic factors, markedness (learners more often transfer unmarked L1 forms than marked forms), prototypicality (learners do not transfer non-prototypical meanings), psychotypology (language distance influences transfer), etc. (Ellis, 2008: 396–397; Odlin, 1989: 99–101, 137, 144). For instance, Odlin (1989, cited in Doughty and Long, 2008: 448–450) provides an example of Spanish learners of English using double negators, e.g. *I **didn't** see **nothing***. The native language translation would also have two negators – ***No** vi **nada***. The linguist considers a claim about cross-linguistic influence to be plausible in this case. Odlin believes that *I **didn't** see **nothing*** may reflect the influence of a non-standard variety of the L2, and the error may occur due to natural principles of language acquisition rather than L1 transfer. Modern linguists are less categorical than the linguists of previous generations described at the beginning of this section, and are more wary of drawing hasty conclusions. This concerns not only those who specialize in language transfer. Many Universal Grammar researchers also acknowledge that there are various factors beyond Universal Grammar which may influence L2 acquisition, e.g. "UG is not a comprehensive theory of the acquisition process; many other factors enter into the language-specific instantiation of principles and parameters" (Flynn and Martohardjono, 1994: 319).

The fact that transfer is found to play a role in speech perception is important for this study. Latvian and Norwegian pilots might assimilate the English sounds which they hear to their native sounds. The English sounds which are similar to Latvian and Norwegian sounds, but are not identical, might be assimilated to the wrong category of native sounds by the listeners. Pilots might also have problems perceiving the sounds which do not appear in Latvian and Norwegian at all.

3 RP vowels in connected speech

In this chapter I will touch upon the peculiarities of the speech of English native speakers – the users of Received Pronunciation[2] (henceforth *RP*), as only a *mutually understandable* language, or the language understood by the great majority of listeners, is used by pilot and controller training organizations (ICAO, Manual on the Implementation of ICAO Language Proficiency Requirements, Doc 9835 AN/453, 2004: 2–10, 3.7.1). I will provide a brief description of vowels and some examples of reduction processes which occur in fast speech, namely elision, assimilation, and some other ways vowels behave in connected speech. I will focus on the behaviour of RP vowels. I will also include short sections on processes of vowel change and prosody.

As already mentioned I could, unfortunately, not study both consonants and vowels due to time and space limitations. After making a brief comparison of Latvian and English consonants and vowels, and of Norwegian and English consonants and vowels (see appendix 1), and after studying the phonetics presented in textbooks for pilots (see section 5.3) and looking at some studies on speech intelligibility when only consonants or only vowels are replaced by noise (Kewley-Port *et al*., 2007: 2365–2375; Owren and Cardillo, 2006: 1727–1739; Stilp and Kluender, 2010: 12387–12392), I came to the conclusion that both consonants and vowels are equally, or almost equally, important for the perception of messages in aeronautical communication. The results of previous studies differ significantly. Owren and Cardillo (2006: 1732) state that listeners participating in their research were better at discerning word meaning from consonants than from vowels. While Stilp and Kluender (2010: 12389) claim that the intelligibility of 100%-vowel-replaced sentences was significantly better than 100%-consonant-replaced sentences, their results also emphasize the importance of information change, i.e. the message that is to be delivered, rather than the role that consonant and vowel segments play in the real-time production and perception of speech. In Kewley-Port, Burkle and Lee's (2007: 2374) research, vowel information was found to have a 2:1 benefit over consonant information for speech intelligibility in both young and elderly listeners. By comparing Latvian and English consonants and vowels, and Norwegian and English consonants and vowels, I found that both

[2] Received Pronunciation – 'the form of British pronunciation that many educated people in Britain use, and that is thought of as the standard form' (*Longman Dictionary of Contemporary English*, 2009).

consonant and vowel pairs differed in these languages and were worth researching. Moreover, both consonant and vowel sounds were present in phonetic exercises for pilots to an almost equal extent. As I did not find any obvious reason why it would be better to study consonants more thoroughly than vowels or vice versa, I chose vowels for reasons of personal interest. When I started looking for available literature, I found more data on the processes consonants undergo in fast and/or informal speech, and I decided to look at these processes for vowels in order to identify whether vowels also undergo elision, assimilation, or any other type of reduction.

In this study, I took RP as the basis for my analysis. RP is not the only variety of English recognized by the International Civil Aviation Organization (ICAO), which states that any variety of English which is *mutually understandable* is acknowledged by pilot and controller training organizations (ICAO, Manual on the Implementation of ICAO Language Proficiency Requirements, Doc 9835 AN/453, 2004: 2–10, 3.7.1). In order to achieve the minimum required proficiency level for radiotelephony communication (Operational Level 4), the pilot is allowed to have an accent or a localized regional variety of English: "pronunciation, stress, rhythm, and intonation are influenced by the L1 or regional variation but only sometimes interfere with ease of understanding" (*ibid*.: A-8). What ICAO language specialists stress is intelligibility. The language of the pilot should be clear enough to be comprehensible for native speakers of English and non-native-speaking colleagues regarding common, concrete and work-related topics. "Intelligible language" excludes incorrectly pronounced sounds, which lead to the change of word meaning (Kaurāte, 2011). While aeronautical language experts do not insist on RP, they do encourage its use for practical reasons (Stevens, the managing director of Mayflower College, 2012: personal communication). RP is believed to be the standard spoken British English, and the most typical model for learners taught in many places of Europe (Hughes *et al*., 2005: 2). RP is a recognized *intelligible* variety of English. It is worth noting that the ICAO Language Proficiency Requirements also concern native speakers of English, and they are also supposed to take an examination, as it is necessary to ensure that the speech of the native speaker is distinct, not too fast and absolutely clear for non-native speakers of English.

Many speakers of native languages other than English complain that they do not have problems communicating in English with foreigners, but when it comes to native speakers of English they feel lost and are not able to catch up with the tempo of the native speakers. The reason could be that everyone talks more quickly in their mother tongue, and this does not apply

to native speakers of English only. As for communication in the aviation sphere, fast speech is often the result of urgency – the delivery of an important message in a hurry. Due to time pressure on the speaker, the speaker can become breathless, can begin to speak in gasps, simplify segments as much as possible and begin to speak in a raised voice range (Brown, 1990: 124).

3.1 What a vowel is

In this thesis, I concentrate on the spoken, not written, language. What I will refer to as vowels is thus not the letters, but the *speech sounds* which are produced by various movements of the speech organs. There are two criteria for assigning sounds to the vowel category. Firstly, their production *does not involve any closure*, i.e. "when the airflow from the lungs to the outside ear is cut off" (as in the initial and final sounds of the words *pat* and *bag*) (Hughes *et al*., 2005: 36). Secondly, the production of vowels *does not involve any narrowing of the vocal tract* to the extent that audible friction is created (as in the initial and final sounds of *fizz* and *sash*) (*ibid*.).

Vowels are described in terms of *tongue position* and *lip-shape* (Ball and Rahilly, 1999: 93; Giegerich, 1993: 14–16; Hughes *et al*., 2005: 37). A description of a vowel's tongue position indicates which part of the tongue is raised towards the roof of the mouth in producing it, how far the tongue is raised and how far to the front/back the highest point of the tongue is. A description of lip-shape shows how spread or rounded the lips are. Cardinal vowel charts (see section 4.1.1 figures 1–6, and section 4.2.1 figures 7, 8, 10–12, 14–16) represent much of this information. The cardinal vowel chart represents the area in the mouth which shows the physical limits on how far up, forward, down and back the highest point of the tongue can be moved (Bird, 2005: 28). In English (and Latvian (Grigorjevs, 2008: 170), but not Norwegian, where lip-position is independent of tongue-position (Bird, 2005: 31)) the lip-position of all the vowels corresponds systematically to the tongue-position, and is also reflected in the cardinal vowel chart, i.e. back vowels tend to be rounded, central vowels tend to be neutral, but front vowels unrounded or have spread lips.

A distinction relating to tongue position is made between vowels with a relatively stable tongue position, *monophthongs*, represented by a single vowel symbol, and vowels with a change in tongue position, *diphthongs*, represented by two vowel symbols (Bird, 2005: 28; Giegerich, 1999: 17) (for a more detailed descriptions of English, Latvian and Norwegian monophthongs and diphthongs, see sections 4.1.1 and 4.2.1). Diphthongs are, however, considered as one

phoneme. A diphthong is "a voluntary vocalic glide within one syllable from one vowel quality in the direction of another" (Nilsen, 2010: 100). The first symbol indicates the beginning of the glide, and the second the direction of the glide. The tongue does not necessarily reach the target; the direction of the tongue is the feature that characterizes the diphthong (*ibid*.: 99).

Giegerich (1999: 13) interestingly points out that "the vowel in almost any given English word will vary greatly from one accent of the language to another – in fact, much more so than most consonants would". This observation indicates that, unfortunately, vowel sounds in English display a complex mixture of the different dimensions of articulation, and deserve special attention on the part of the listener.

3.2 The speed of speech

The speed of speech is one of the main reasons why *what was actually said* is not necessarily the same at all as *what should have been said*. The problem is especially topical in aviation contexts, where it is crucial to communicate as much information as possible within a potentially limited amount of time.

Even though the speed of speech is often discussed as a listener's qualitative judgement, based on a global impression, the speed of speech (or the amount of speech in a given time) can be measured. The speech rate is a measure which includes the *articulation rate*, i.e. actual speech excluding time devoted to pausing, and pause time (Towell, 1987: 163). Scholars' numbers regarding comparatively "slow", "high" and "comfortable" speech delivery are not the same, but their calculations do not differ dramatically. A number of factors can influence the outcome of each particular calculation, the main ones being the language of delivery and the purpose of delivery. For example, Zybatow (2010: 62) suggests that a fairly high speed of delivery for English and Spanish speech is 150 words per minute, while for Italian it is only 130 words per minute. According to Kelly and Watson (1989: 210), people can listen and recognize words at a rate of about 400 to 500 words per minute, and the usual speaking rate is about 100 to 125 words per minute. Seleskovitch (cited in Setton, 1999: 30) recommends that an input rate of 100–120 words per minute is the most comfortable one for interpreters, and, as opposed to Kelly and Watson (1989: 210), considers it to be slower than common informal speech. Baumeister and Bushman (2009: 247) find a speech rate of 100 words per minute to be slow, and 200 words per minute to be fast.

The speed of speech with which pilots and controllers have to deliver standard aeronautical phraseology in non-routine situations, is defined in ICAO Standards and constitutes 100 words per minute (Ramute, 2010, cited in Sinkova, 2010: B-2). As may be seen from the calculations of the scholars cited above, such speech delivery is rather slow. However, the problem is that pilots and controllers do not follow these regulations on a regular basis as they are forced to speak faster to handle the job (Sinkova, 2010: A-3, B-2). Pilots obviously face difficulties which are due to a rapid speech delivery, as real communication sometimes does not correspond to the Standard recommended in ICAO documents.

Native speakers communicate at length with a natural effortless flow, and their production of speech functions in a highly automatic, reflex-like way. Empirical research on fluency indicates that speech and articulation rates increase with overall fluency (Freed, 1995: 123–148; Towell, 1987: 157–181; Towell *et al*., 1996: 84–119; Wood, 2001: 573–589). Interestingly, in studies on fluency, Chambers (1997: 535–544), Raupach (1987: 123–155), Towell, Hawkins and Bazergui (Towell, 1987: 157–181; Towell *et al*., 1996: 84–119) analyse factors which contribute to fluency and come to the conclusion that becoming fluent is not about speaking faster, but about pausing less often, pausing at the appropriate junctures in an utterance, not transferring pausing pattern from L1 to L2, and increasing the length and complexity of the linguistic units which are uttered between pauses.

Regarding pausing patterns, there are two types of pauses in any language: pauses to breathe and logical pauses. What the scholars cited in the previous paragraph mean by pauses is logical pauses. Campione and Veronis (2002, cited in Hilton *et al*., 2011: 218–219) studied pauses in German, Italian, English, French and Spanish and concluded that pauses shorter than 200 ms are difficult to discriminate from plosives, but some brief pauses could be as short as 60 ms. Another piece of research on the duration of pauses was conducted by Tsao and Weismer. They suggest that the lowest threshold of what constitutes a meaningful pause is 150 ms (Tsao and Weismer, 1997: 862).

Taking into account the factors which contribute to fluency, pilots probably face problems connected not only with the speed with which their native-speaking colleagues articulate what they say, but also problems related to an increase in the length and complexity of words between pauses (Heselwood and Upton, 2010: 150). On the other hand, logical pauses make it easier for the listeners to cognitively digest the input (Oliveira, 2002: 49).

The speed of speech and reduction processes go hand in hand. In order to increase the speed of speech, the articulatory processes become less precise and some information can be deleted or reduced. The more reduction that takes place, the less time is needed to produce an utterance. Some reduction processes present in English are treated below.

3.3 Elision

The process of elision is a common process in informal or fast speech. Elision is described in many books on phonetics and pronunciation (e.g. Brown, 1990; Gimson, 1989; Nilsen, 2010; Wells and Colson, 1971), and involves a considerable number of English consonants and several vowels which are commonly elided. In this section I will give a general overview of the process and touch upon only the most common English vowels involved in this process.

Elision is "the 'missing out' of a consonant or vowel, or both, that would be present in the slow colloquial pronunciation of a word in isolation" (Brown, 1990: 66). In simple words, elision is omission.

Nilsen (2010: 187–188) claims that the only vowel that is commonly elided in English is /ə/. According to Nilsen, this vowel may be dropped in initial or medial position in a word. An initial /ə/ may be dropped only when it is followed by a stressed syllable starting with a nasal, /l/ or /r/, for example *they should ally their forces* /ðeɪ ˈʃʊdlaɪ ðeə ˈfɔːsɪz/ (*ibid*.: 188). A medial /ə/ may be elided if followed by an unstressed syllable and preceded by a stressed one (and the following consonant must be a nasal, /l/ or /r/), e.g. *history* /ˈhɪstərɪ/ /ˈhɪstrɪ/ (*ibid*.). In some cases the first syllable of the endings in words which end with *-ary*, *-ery*, and *-ory* is dropped even if there is an intervening unstressed syllable, e.g. *category* /ˈkætəˌgɔːrɪ/ /ˈkætəgrɪ/ (*ibid*.).

In his treatment of elision which occurs in rapid, colloquial speech (apart from word internal elision, when the weakly accented syllables undergo a process of gradation, and those associated with weak forms), Gimson (1989: 300) mentions not only the *phonemic elision* of the English vowel /ə/, but also *allophonic variation of vowels* – variations which are insufficient to cause a change of phoneme. When "one syllable ends with a closing diphthong (i.e. one whose second element is closer than its first, /eɪ, aɪ, ɔɪ, əʊ, aʊ/) and the next syllable begins with a vowel, the second element of the diphthong may be elided", e.g. *hyaena* /haɪˈiːnə/ /haˈiːnə/ (*ibid*.). Similar smoothing occurs also at or in the vicinity of word boundaries, e.g. *I may as well* /aɪˌmeəzˌwel/ (*ibid*.). *Allophonic variation of vowels* will never change the meaning of the word it occurs in (Gordon-Brannan and Weiss, 2007: 47; Reynolds and Fletcher-Janzen, 2004: 74).

In his study of the phonetic facts of normal informal speech, Brown (1990: 75–76) exemplifies many undesirable types of elision which are in apparent conflict with the statement of regularities, e.g. (1) *prices and incomes* /'praɪsɪzənd'ɪnkʌmz/ /'praɪsn'ɪŋkʌmz/, (2) *succeed in imposing* /sək'si:dɪnɪm'pəʊzɪŋ/ /sk'si:dm'pəʊzɪn/, (3) *perhaps* /pə'hæps/ /'pæps/, (4) *in this kind of presentation* /ɪn'ðɪs'kaɪndəv'prezən'teɪʃən/ /n'ðɪs'kaɪn'prezn'teɪʃn/, (5) *particularly* /pə'tɪkjʊləlɪ/ /pə'tɪklɪ/, (6) *actually* /'æktjuəlɪ/ /'ækʃlɪ/, (7) *owing to* /'əʊɪŋtʊ/ /'əʊnə/, (8) *going to be* /'gəʊɪntəbɪ/ /'gənəbɪ/, (9) *extraordinary* /ɪk'strɔ:dɪnərɪ/, /'strɔ:nrɪ/, etc. Among a few generalizations that can be made about his examples, Brown (*ibid*.) notes that stressed syllables are not affected by elision (with the exception of /'pæps/), and that elision only takes place in obscure syllables, but never in prominent places in the utterance.

Even though in this thesis I am not studying consonants, it is worth noting that elision of consonants is a likely source of miscommunication, as it can lead to difficulties in distinguishing between the present and past tense, and makes completely different utterances homophonous. For instance, the two utterances below would sound the same with the elision of the past tense /d/: *they mentioned this to me* /ðeɪ'menʃnðɪstə'mi:/ and *they mention this to me* /ðeɪ'menʃnðɪstə'mi:/ (Nilsen, 2010: 190).

3.4 Assimilation

Assimilation is another process which is likely to occur in fast colloquial speech. It is sometimes present also in slow formal speech, though to a lesser extent. Assimilation takes place when a phoneme is coloured by neighbouring phonemes, or itself influences the articulation of other phonemes (Nilsen, 2010: 180). Assimilation can be *phonemic* and *non-phonemic*. "Phonemic assimilation is characterized by a change in one of the distinctive features of a phoneme, so that the sound produced is a realization of another phoneme. Phonemic assimilation will therefore typically have a change in place, force, or manner of articulation" (*ibid*.: 181). Phonemic assimilation may be *complete*, when the two phonemes become identical, or *partial*, when the two phonemes do not become identical, but more similar to each other (*ibid*.: 180). Phonemic assimilation involves consonants. This type of assimilation is widely described in books on phonetics (e.g. Bird, 2005: 87–89; Giegerich, 1993: 288–290; Gimson, 1989: 297–300; Nilsen, 2010: 180–187; Wells and Colson, 1971: 53–56).

Non-phonemic assimilation takes place when one segment influences another and produces allophonic variation (Crowley, 2009: 66). This type of assimilation involves both

vowels and consonants. According to Bird (2005: 81–83), allophonic variation in English vowels concerns mostly (1) shorter and longer allophones before fortis and lenis consonants, (2) allophonic variation in tongue-position for /ɪ/ and /ʊ/, and (3) nasalization of vowels influenced by nasal consonants. I will also include a description of variation in voice onset time (4).

(1) Some English vowel phonemes (both monophthongs and diphthongs) are pronounced shorter or longer than the others according to the context. Specifically, "if any vowel occurs before a fortis obstruent like /s/ within the same syllable, then it will be pronounced slightly shorter than usual; if any vowel occurs before a lenis obstruent like /z/ within the same syllable, then it will be pronounced slightly longer than usual" (*ibid*.: 81), e.g. *seat* /si:t/ [si·t] (shorter), *see* /si:/ [si:] (usual length), *seed* /si:d/ [si:·d] (longer). As it is a non-phonemic assimilation, a long phoneme /i:/ does not turn into a short phoneme /ɪ/ or opposite, but is realized as multiple spoken variants.

(2) "/ɪ/ and /ʊ/ have a special tongue-position (allophone) in two particular contexts, i.e. when unstressed and (a) in morpheme-final position, and/or (b) before another vowel within a word" (*ibid*.: 82). In these contexts /ɪ/ and /ʊ/ are closer to /i:/ and /u:/, but remain short, e.g. [i] in *cre'ate*, [u] in *'punctuate*.

(3) English basically has oral vowel phonemes, i.e. vowels are pronounced with air passing through the mouth. However, when a nasal consonant precedes or follows a vowel, the part of the vowel closest to the nasal consonant is usually nasalized, i.e. air from the lungs exits through the nasal passage (Finegan, 2011: 119). For example, *sit* (oral), *sin* (nasal) or *light* (oral), *lime* (nasal). An oral vowel and a nasalized vowel constitute allophones of a single phoneme in English and cannot signal a meaning distinction.

(4) Voice onset time is a feature of the production of stop consonants, which also affects the duration of the voicing of a vowel occurring with a stop consonant. In the production of stop consonants, i.e. voiced *b, d, g* and voiceless *p, t, k,* the airflow is stopped. Voice onset time is the interval between the release of the closure and the start of the voicing of the vowel or consonant (Ladefoged and Johnson, 2010: 151). Voice onset time deals with the waveform of a sound. It is measured in milliseconds "from the spike in the release of the stop closure to the start of the oscillating pattern indicating the vibrations of the vocal folds in the vowel" (*ibid*.). Voiced stops have negative voice onset time, as the vocal cords start vibrating before the stop is released; voiceless stops have zero voice onset time, as the vocal cords start vibrating at the time the stop is released, and some aspirated stops have positive voice onset time, as the vocal cords start

vibrating after the stop is released (Ladefoged and Johnson, 2010: 151). In English, stop consonants that differ in voice onset time in initial position, differ in the length of the preceding vowel in word-final position, e.g. as in *bad* and *bat* (Kreiman and Sidtis, 2011: 275). Experiments showed that listeners are very sensitive to voice onset time and use it to categorize the plosive they are hearing as voiceless or voiced (Ashby and Maidment, 2005: 92).

The listener may confuse the voicing of the vowels with the voicing of the consonants (Cleghorn and Rugg, 2011: 51). For instance, the sequences *aba* and *apa* may sound alike, however, there is a slight break in the vocal cord activity during the *p*. It is not easy to distinguish the voicing of the consonants from the voicing of the vowels for non-native speakers of English (*ibid*.).

3.5 Liaison

Liaison is a process which refers to a transition or link between sounds or words (Skandera and Burleigh, 2011: 57). Another definition describes liaison as a transition between words in connected speech, particularly when this involves an unusual phonetic feature (*ibid*.). There are many linguists who describe only the most prominent examples of liaison: *the linking r* and *intrusive r* (Ball and Müller, 2005: 260–261; Giegerich, 1993: 280–283; Gimson, 1989: 302–304). A third definition says that liaison is a link between sounds or words through the insertion of an additional sound, e.g. through the insertion of a semi-vowel, or glide, e.g. *to_England* tuʷ ɹŋgləɲd/ (Skandera and Burleigh, 2011: 58). Although inserted semi-vowels do not necessarily fit into the category of vowels, it is correct to claim that vowels also participate in liaison, as the vowels which occur before and after an inserted sound are also affected by this process.

Although I have included a short overview of liaison, it is not a process I am going to cover further in this thesis.

3.6 The process of vowel change

As may be seen from the above observations, vowels, together with consonants, take part in a number of reduction processes in fast speech. Still, not all the cases of vowel simplification or change in informal speech can be explained by these linguistic processes. Historically, English vowels have undergone considerable changes, and, according to Brown (1990: 80) and Gimson (1962: 139), there is every reason to suppose that the process of vowel change is going on now. Brown (1990: 81) observes that the distinction between /ʊə/ and /ɔ:/ has been lost, e.g. *poor* and *paw* have become homophones. In his data Brown (*ibid*.) also provides examples of the

realization of /ɪə/ as a central vowel rather more front than that in *bird, fur*, e.g. *the year before* /ðə'jɪəbɪ'fɔ:/ [ðə'jɜ̆bɪ'fɔ]. As I found these sources comparatively outdated in relation to present pronunciation, I turned to the *Oxford English Dictionary* to check the pronunciation of these words. The dictionary gives two variants of pronunciation for *poor*, /pɔ:/, /pʊə/ (*Oxford English Dictionary*, 2011). The word *year* also has two versions /jɪə/, /jɜ:/ (*ibid*.). This shows that the process of vowel change is ongoing, and the "unusual" pronunciations noticed by Brown in informal speech have already entered the modern pronunciation. For instance, the so-called "unusual" pronunciation of *poor* has already been placed in the first place in the *Oxford English Dictionary*. Native speakers are the first ones to follow the "modern trends" of the language, while their non-native-speaking colleagues may still use non-updated versions. This creates another source of problems for non-native listeners.

3.7 Intonation and stress

Intonation is a significant part of the language system, and it is tightly connected with language perception. There are no languages which are monotonous. If speech was presented in monotone, listeners most probably would not understand most of it. Intonation is the use of pitch to create a melody of speech (Wells, 2006: 1). Researching intonation, linguists study how the pitch of voice rises and falls, how speakers use this pitch variation to convey linguistic and pragmatic meaning, they study the rhythm of speech and how the interplay of accented, stressed and unstressed syllables functions (*ibid*.). This is a broad theme. In this thesis I will only touch upon prosody, i.e. the position of word-stress in English, and provide a brief description of the rhythm of the language.

It is not hard to find cases where non-native speakers understand the meaning of all the words pronounced by the native speaker in isolation, but where they cannot distinguish these words in connected speech. The problem is that the listener is not used to the specific sentence melody produced by the interlocutor, which may be completely different from that of his L1. As I have already mentioned, the use of pitch helps create sentence melody. "When the vocal folds vibrate under the pressure of air expelled from the lungs, a sound is produced at a certain pitch. This pitch may be modified by varying the frequency of vibration of the vocal folds. A stressed syllable will be pronounced with either a step-up or a step-down in pitch" (Nilsen, 2010: 74).

Thus stress in English words pronounced in isolation is marked not only by loudness, but also by pitch (*ibid*.). According to Fry's research (1955, 1958, cited in Hayes, 1995: 6), loudness

has the least effect on stress perception, duration changes have a greater effect, but the strongest effect is achieved by altering the pitch contours. There are multiple degrees of stress: primary, secondary, tertiary, etc (Fry, 1955, 1958, cited in Hayes, 1995: 25). In contrast with many other languages (e.g. Latvian (Bond *et al*., 2003: 528), Czech, Finnish, Polish, French (Kreidler, 2004: 179), though not Norwegian (Husby *et al*., 2008: 20)), stress is variable in English. The stress of a polysyllabic word may be on the first syllable (e.g. *'alligator*), the second (e.g. *com'mensurate*), the third (e.g. *inter'vention*) or the fourth (e.g. *intelli'gentsia*). However, the position of English word stress is usually fixed and unvarying in any particular word (Bird, 2005: 92). In English, stress is *culminative* at the word level (as well as in Latvian (Hulst, 1999: 815) and Norwegian (Andersen, 1986: 274)), i.e. each word or phrase has a single strongest syllable (Hayes, 1995: 24). Already at the end of 18th century, and probably long before that, it was stated that stress is regular in certain groups of English words (Walker, 1791, cited in Kreidler, 2004: 199). That is, there are general rules which account for the place of stress in many English words. Stress rules are described in grammar books. These rules are based on syntactic, morphological and phonological information (*ibid*.: 180).

In English there are some words which can be changed to different words due to incorrect use of stress (e.g. *reefer* and *refer*, *Billow* and *below*, etc). While the incorrect use of stress will hardly change the meaning of the word it occurs in, the result may still sound unintelligible, or at least be difficult to decode.

The main function of stress is to maintain rhythm in connected speech (Giegerich, 1993: 181). Metrical Stress Theory (Hayes, 1995: 1) also states that stress is the linguistic manifestation of rhythmic structure. The theory represents stress as a hierarchically organized rhythmic structure both in language (Liberman, 1975: 179) and music (Lerdahl and Jackendoff, 1983: 327–328). English, (together with Norwegian (Popperwell, 2010: 147)), is a *stress-timed* language: stresses occur at roughly equal timing intervals (Giegerich, 1993: 181); unlike Latvian, for example, which employs syllable rhythm (Bond *et al*., 2003: 528): syllables come at equal intervals, taking the same relative length of time (Kess, 1992: 52). Such equality in time is called *isochrony*; it is maintained by variation in the delivery rate of individual syllables (Giegerich, 1993: 181). Even though English (and Norwegian) is a stressed-timed language, intervals between stresses are not perfectly evenly spaced. In studies of objective and subjective rhythm it was noted by a number of linguists (Donovan and Darwin, 1979, and Allen, 1975, cited in Hardcastle *et al*., 2010: 554; Lehiste, 1977, cited in Couper-Kuhlen, 1993: 12) that listeners

perceive stresses as more perfectly regular than they really are. This means that listeners have a tendency to overestimate short intervals and underestimate long intervals by evening up the number of syllables in stress feet.

As English (and Norwegian) is a stressed-timed language, stresses which occur on isolated words are often modified when these words become part of sentences and stresses come too close together, or, on the contrary, when they come too far from one another. Most frequently sentences are modified by dropping some of the stresses (Ladefoged and Johnson, 2010: 116). It may also happen that stress in a polysyllabic word is on one syllable in one sentence, and on another syllable in another (*ibid*.: 116–117).

4 A contrastive analysis of the Latvian, Norwegian and English vowel systems

In this chapter I will discuss the use of English in Latvia and Norway. Then I will deal with the Latvian and Norwegian languages and look into the differences between Latvian and English vowel sounds and Norwegian and English vowel sounds. I will divide the potential problems for Latvian and Norwegian pilots into two categories: (1) problems with vowels (2) problems with vowels in context.

There is clear evidence that English is more widely used in Norway than in Latvia. However, the linguists Kachru and Crystal (Crystal, 2003: 60), who see the spread of English around the world as three concentric circles which represent the way the language has been acquired and is currently used, place both Latvia and Norway into the same expanding (or extending) circle. This circle involves "those nations which recognize the importance of English as an international language, though they do not have a history of colonization by members of the inner circle, nor have they given English any special administrative status" (*ibid*.). However, the three concentric circles do not reflect the nuances in the way the language is currently used. It is obvious that English has had different fortunes in Latvia and Norway. Ellis' (and a number of other linguists') distinction between *Second Language* role and *Foreign Language* role in a country can be used to throw light on the differences. In the definition of *Second Language*, Ellis (2008: 6) identifies not only an institutional role, but also a social role of the language in the community, i.e. how the language functions as a means of communication among members for whom English is not their mother tongue. At this point there is a huge difference between the use of English in Latvia and Norway. In Latvia, English is hardly ever used in naturally occurring social situations and is acquired only through study with the help of guidance. Russian holds the role of the second language in Latvia, as an after-effect of the Soviet occupation. In contrast, in Norway learners have more of an opportunity to acquire the language both in naturalistic and classroom settings. According to Johansson and Graedler (2005: 185), English has spread into new domains and everyday discourse in Norway in recent years. One of the reasons is the comparatively high number of immigrants in Norway who speak some language other than Norwegian and who use English as a means of daily communication. The Norwegian TV

network has many channels in English. This creates an opportunity to learn English by watching TV.

As English is much more frequently used in Norway than in Latvia, Latvians are assumed to have more problems with the perception of English speech than Norwegians.

4.1 Latvian–English

Latvian pilots are likely to face a number of problems with English language perception when communicating with their native-speaking colleagues, not only because English is not widely used in Latvia, but also because there are substantial differences in Latvian and English phonology.

The Latvian language belongs to the Baltic branch of the Indo-European language family. Latvian is spoken by approximately 2 million people and is the only official state language of Latvia (Steinbergs, 2010).

4.1.1 Problems with vowels

Although the Latvian alphabet has 9 vowel letters, and the English alphabet only 6 vowel letters, the number of monophthongs in these two languages is the same. There are 12 monophthongal vowel phonemes in Latvian and 12 monophthongal vowel phonemes in English, but not all of them are identical. It is tempting to distinguish between vowels that exist in both languages, but differ somewhat in realization, and vowels that are missing in one of the languages. It is problematic to operate with two clear categories here because many English and Latvian sounds overlap to different degrees. That is why it seems very subjective to say that some sounds are found in both languages, whereas other sounds are not. I tried to distinguish between these two cases on the basis of their position in the vowel diagrams, the lip shape, and my personal experience with these sounds. As it is still problematic to decide how different two sounds need to be to constitute totally different vowels, I prefer to explain the degrees of overlap in each case rather than divide them into two clear-cut categories.

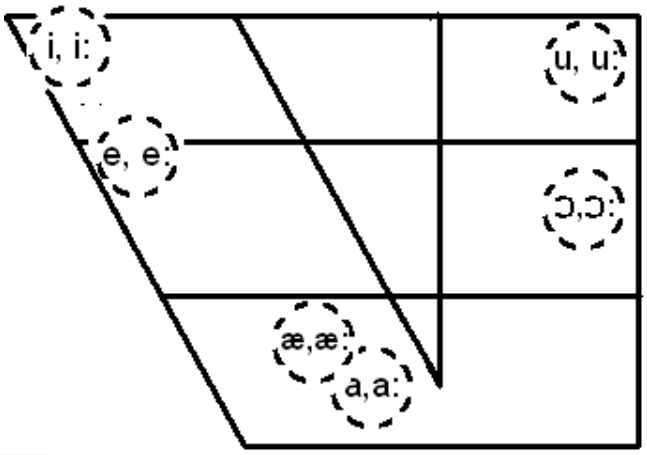


***Figure 1*, Latvian monophthongs (based on Grigorjevs, 2008: 199[3])**

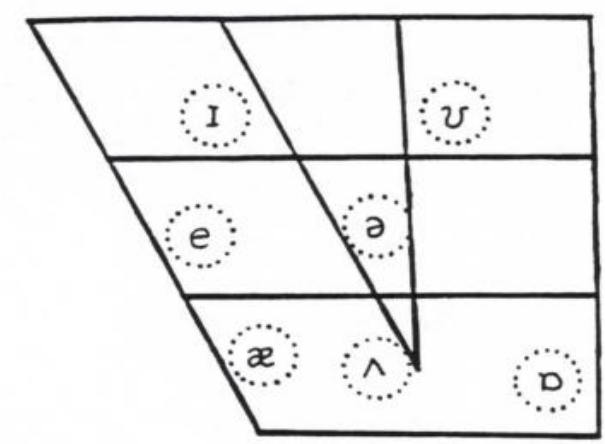


***Figure 2*, RP short monophthongs (Bird, 2005: 29)**

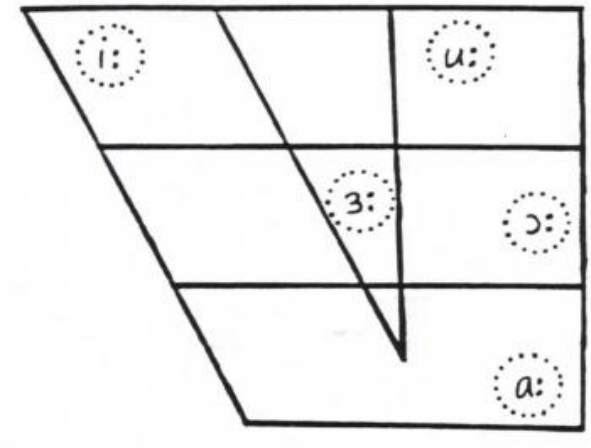


***Figure 3*, RP long monophthongs (Bird, 2005: 29)**

[3] I placed Latvian monophthongs in the table myself according to the descriptions of vowel qualities found in Grigorjevs (2008: 199), the most updated source on the Latvian vowel system. In this source vowel phonemes were indicated outside the table.

The English mid central vowel phonemes /ə/ and /ɜ:/ are the ones that come closest to the category of sounds with no counterparts in Latvian. Latvian has no completely central vowels, although /æ/ and /æ:/ come fairly close (Grigorjevs, 2008: 199). The English vowel phoneme /ə/ is used in the weak forms of function words, and is a very frequently produced vowel. Vowels in unstressed position do not undergo qualitative reduction in Latvian. That is why the perception of the weak forms of function words could create particular difficulties for Latvian speakers.

Latvian speakers frequently replace /ɜ:/ with the Latvian broad long /æ:/ (Kaurāte *et al.*, 1985: 34), which is the Latvian sound which comes closest to it. While in standard aeronautical phraseology mistakes are almost excluded, as radiotelephony speech is based on simplified English and is developed to eliminate misinterpretations due to insufficient knowledge of English (ICAO, Manual on the Implementation of ICAO Language Proficiency Requirements, Doc 9835 AN/453, 2004: 1.2.4, 2.3; Sinkova, 2010: 12), the failure to distinguish these two sounds might lead to misunderstandings using plain language. For example, the message *heard speed* /hɜ:d spi:d/ might be perceived as *add speed* /æd spi:d/ by the Latvian speaker.

There are other vowel phonemes which differ slightly in articulation. According to the Perceptual Assimilation Model (as well as the other theories which support the negative influence of the L1 on the target language, see section 2.3), these vowel phonemes could be especially difficult for listeners, as they would have a tendency to assimilate non-native phonemes to the native ones that are perceived to be the most similar articulatorily speaking (Best *et al.*, 2003: 2891). For instance, Latvian speakers tend to use the Latvian /ɔ/ (e.g. Latvian *boss* (boss), *kross* (cross)) for the open back short English vowel phoneme /ɒ/; however, the English /ɒ/ is articulated in a more retracted and open position (Kaurāte *et al*., 1985: 30; Laua, 1997: 20; Roach, 2009: 14). Latvian speakers face the same problem with the open back long vowel phoneme /ɑ:/ as they do with the open back short vowel phoneme /ɒ/, as the articulation of the English /ɑ:/ is more retracted and open than that of the Latvian /a:/ (e.g. Latvian *kā* (how), *māk* (can)) (Kaurāte *et al.*, 1985: 29–30; Laua, 1997: 21).

The English mid-open back long /ɔ:/ is approximately of the same quality as the Latvian narrow /ɔ:/, but somewhat more open. The phomene /ɔ:/ occurs only in foreign words in Latvian (e.g. *bioloģija* (biology), *opera* (opera)). The English sound is pronounced with lesser rounding while for its Latvian counterpart the lips are both closely rounded and protruded (Kaurāte *et al*., 1985: 31). The English close front short /ɪ/ is more central than its Latvian analogue (e.g. Latvian *bite* (bee), *films* (film)) (Roach, 2009: 14; Rozenbergs, 1969: 7). Compared to the Latvian /i/, it is

produced with lesser tension and with the middle of the tongue in a slightly lower and more retracted position (Kaurāte *et al*., 1985: 27). The close front long phoneme /i:/ is similar to its Latvian counterpart, but the latter is tenser and closer , i.e. the middle of the tongue rises higher towards the hard palate in the Latvian sound (e.g. Latvian *pīt* (weave), *sīlis* (jay)) (*ibid*.: 26).

The English open central short /ʌ/ is not as open as the Latvian short /a/ (e.g. Latvian *kam* (whom), *masts* (mast)) (Laua, 1997: 21). In the Latvian variant the lips are less spread and the sides of the mouth are less retracted (Kaurāte *et al*., 1985: 34). The English close back short /ʊ/ is not as retracted as Latvian /u/ (e.g. Latvian *bullis* (bull), *gudrs* (clever)). The Latvian /u/ is pronounced with the lips not only rounded, but also protruded (Laua, 1997: 20). As regards the English close back long /u:/, it is similar to the Latvian /u:/; however, it is neither as back nor as close as its Latvian counterpart (e.g. Latvian *jūs* (you), *būt* (be)).

When it comes to the English mid-open front sound /e/, it is more open than the Latvian /e/ (e.g. Latvian *bet* (but), *tests* (test)). The principal differences in the articulation of the English /e/ are the following: the middle of the tongue is lower and more retracted, while the corners of the mouth are less spread (Kaurāte *et al*., 1985: 28). In the production of the English sound, the lips are more neutral. As for the English almost fully open front /æ/, it is more open and fronted than its Latvian counterpart (e.g. Latvian *ēd* (eat), *bēda* (misfortune)), and produced with greater lip-spreading (*ibid*.: 29). Grigorjevs (2008: 197) says that there are not enough data to describe a precise articulation of the Latvian /æ/. He says that some linguists had previously used the IPA sound /ɛ/, but then they discovered that it does not correspond to the Latvian /æ/, as the /ɛ/ is actually closer to the Latvian broad /e/ than the Latvian /æ/. The Latvian /æ/ is intermediate between /ɛ/ and /æ/. The Latvian /æ/ and /æ:/ are more central than the IPA /æ/, /æ:/ and /ɛ/, /ɛ:/ in addition to being in between them on the vertical axis.

In the practical part I will try to find out whether the pilots would assimilate the vowel phonemes discussed above to their counterparts in Latvian or other vowel phonemes, if they are assimilated at all, and whether the differences between similar vowel phonemes in the languages are so significant as to lead to the misunderstanding of words which contain these phonemes.

I will proceed with a contrastive analysis of English and Latvian diphthongs. Diphthongs are transcribed using two symbols, but represent one phoneme which is characterized by tongue movement (Nilsen, 2010: 99). The first symbol indicates the beginning of the glide, and the second symbol the direction of the glide (*ibid*.). There are eight diphthongs in RP. They are /eɪ/, /aɪ/, /aʊ/, /ɔɪ/, /ɪə/, /eə/, /əʊ/, /ʊə/ (see figures 5 and 6; Bird, 2005: 30; Hughes *et al*., 2005: 51–52).

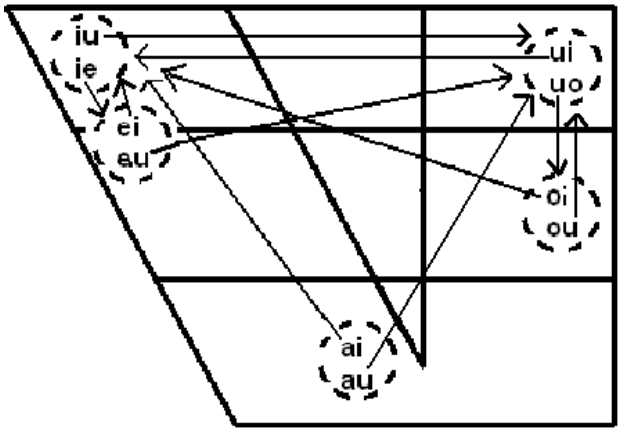


***Figure 4*, Latvian diphthongs (Kaurāte *et al.*, 1985: 37–44[4])**

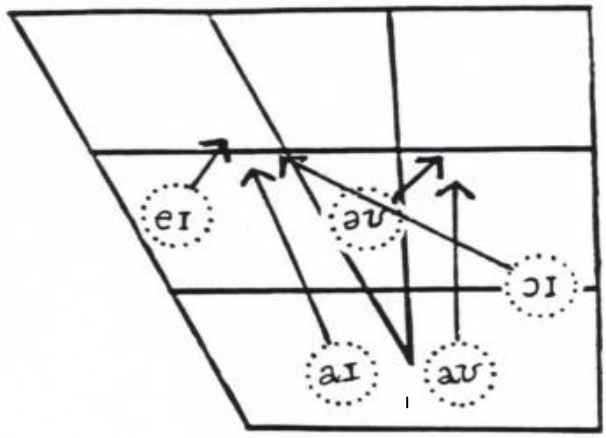


***Figure 5*, RP closing diphthongs (Bird, 2005: 30)**

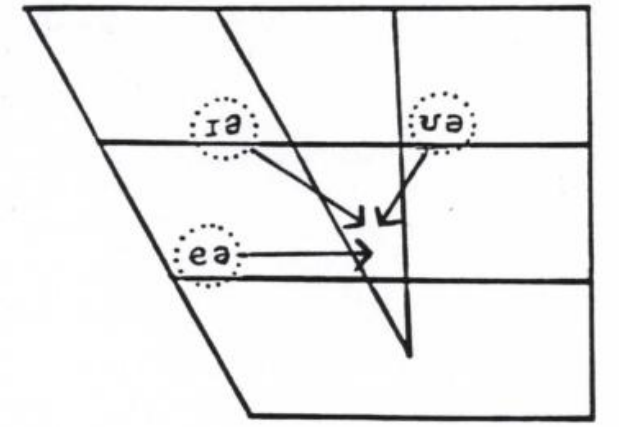


***Figure 6*, RP centring diphthongs (Bird, 2005: 30)**

[4] I placed the Latvian diphthongs in the table myself according to the descriptions of vowel qualities found in Kaurāte *et al*. (1985: 37–44).

When comparing English and Latvian diphthongs, I found differences in the definitions of diphthongs provided by English and Latvian phonologists. Latvian phonologists claim that there are no *true diphthongs* in English, as they define true diphthongs as diphthongs in which both elements are pronounced equally strongly. Latvian phonologists state that all the English diphthongs are *false diphthongs*, as in English diphthong articulation efforts decrease towards the end of their articulation (Kaurāte *et al*., 1985: 37). Comparatively recent literature on English phonology, (e.g. Gimson, 1989; Bird, 2005; Nilsen, 2010), does not provide a distinction between true and false diphthongs, but just define them as closing and centring. However, the notion of *false diphthong* appears in older sources. For instance, the British scholar Stoddart (1858: 118) gives a definition of false diphthongs which is slightly different from that of Latvian phonologists. He uses "false diphthongs" about the diphthongs which are written with two letters, but which are pronounced as one or two monophthongs. Stoddart (*ibid*.) subdivides false diphthongs into four groups: "first, those which serve merely to prolong a single vowel; secondly, those which drop one of the two vowels altogether; thirdly, those which produce a simple sound differing from both the elements; and fourthly, those which do not combine the elements at all, but pronounce them separately". In modern research there is no such thing as a *false diphthong*. What Stoddart was speaking of were *digraphs*. A digraph is "a pair of characters used to write one phoneme (distinct sound) or a sequence of phonemes that does not correspond to the normal values of the two characters combined" (Miller *et al*., 2009: 1). By "not corresponding to the normal values of the two characters combined", Miller means that there is no tongue movement in the pronunciation of the two characters. What is unique about these letter combinations is that they usually follow a rule, e.g. in *b<u>ee</u>t*, *f<u>ee</u>t* the letter combination <u>*ee*</u> is pronounced as /i:/, in *r<u>ea</u>d*, *t<u>ea</u>ch* the letter combination <u>*ea*</u> is pronounced /i:/ (C. Miyata and K. Miyata, 2006: 96). The vowel /i:/ in these words has a stable tongue position, which is why <u>*ee*</u> and <u>*ea*</u> are digraphs but not diphthongs.

Both English and Latvian phonologists agree that there are closing diphthongs (/eɪ/, /aɪ/, /aʊ/, /ɔɪ/, /əʊ/), i.e. diphthongs with a slight closing movement of the lower jaw and of the tongue for the glide; and centring diphthongs (/ɪə/, /eə/, /ʊə/), i.e. diphthongs with a more central /ə/ for their glide (Bird, 2005: 30; Gimson, 1989: 127–149; Kaurāte *et al*., 1985: 37; Nilsen, 2010: 120–132).

The Latvian language enlists ten diphthongs: /ai/, /au/, /ei/, /eu/, /oi/, /ou/ (closing diphthongs), /ie/, /uo/ (opening diphthongs), and /iu/, /ui/ (neither closing nor opening

diphthongs, as they just move forward or backward) (Kaurāte *et al*., 1985: 37; Laua, 1997: 26–27; see figure 4). My readers might be wondering why the Latvian diphthongs /oi/, /ou/ and /uo/ are not written /ɔi/, /ɔu/, and /uɔ/, even though they start in the same place as the monophthong that I symbolize with /ɔ/. The reason is that I base my description of monophthongs and diphthongs on different sources. I have chosen to do so because I wanted to use the most updated available source for describing Latvian monophthongs (namely, Grigorjevs, 2008), who, unfortunately, does not say anything about the Latvian diphthongs. Grigorjevs (2008) discusses two possible symbols for these Latvian short and long monophthongs. The first one is /ɔ/ and /ɔ:/, and the second one is /o/ and /o:/. He argues that the acoustic-auditive quality of these Latvian sounds is still closer to the /ɔ/ and /ɔ:/ than the /o/ and /o:/, despite the fact that the sounds are closer than their Norwegian or RP counterparts. The older sources (Kaurāte *et al*., 1985: 41; Laua, 1997: 19; Rozenbergs, 1969: 13) refer to these Latvian monophthongs as /o/ and /o:/, and the diphthongs as /oi/, /ou/ and /uo/. I could have changed the symbols for the diphthongs, but decided to follow my sources.

In all of the Latvian diphthongs, both elements are strong, distinct and fully pronounced (Kaurāte *et al*., 1985: 37–44). Such a considerable distinction in the sound qualities between the diphthongs in the two languages could result in difficulties for the Latvian speakers in perceiving English diphthongs, as they are not used to the weaker pronunciation of the second element. I suppose that these diphthongs would be more comprehensible in isolation, but less distinct for the pilots' ears in continuous speech. Moreover, in careful or slow speech more vowel elements are maintained than in faster speech, where they are omitted through smoothing (Hughes *et al*., 2005: 53). Kaurāte, a teacher of practical phonetics and phonology at the University of Latvia, and her colleagues (Kaurāte *et al*., 1985: 41–42) noted that all the English diphthongs create considerable production difficulties for Latvian speakers, but particularly the diphthongs /ɪə/ and /eə/. Latvian learners are apt to substitute English /ɪ/ in /ɪə/ with a very close Latvian /i/, without opening the mouth and advancing the jaw. English /eə/ is often substituted by /æə/ by Latvian learners. There are no counterparts for these diphthongs in Latvian. In the practical part, I will try to find out whether the same difficulty also holds for the perception of these diphthongs.

4.1.2 Problems with vowels in connected speech

In this section I will compare several processes which occur in fast or informal speech in relation to Latvian.

The speed of speech

In section 3.2, I came to the conclusion that pilots probably face problems connected not only to the speed with which their native-speaking colleagues speak, but also related to an increase in the number of syllables in linguistic units (word groups or tone units) and the complexity of linguistic units.

Pawley and Syder (1983, cited in Wood, 2001: 577) measured variables of speech associated with fluency. They found that in conversational English speech the norm was to slow down near clause boundaries usually after four to ten consecutive words, and rarely in mid-clause (*ibid*.). According to their estimations, over 50% of fluent units were complete and grammatical clauses (*ibid*.). At clause boundaries pauses normally were shorter than two seconds, and it was not common to pause more than 5 seconds in mid-clause (*ibid*.).

Even though Chafe (1980, cited in Wood, 2001: 577) states that L1 speech in general, irrespective of the language of production, occurs in spurts of two seconds, and contains five words, it seems that the number of syllables in linguistic units and the complexity of the runs of speech which occur between pauses is not the same in different languages. Comparing pausing patterns in English and in French, Grosjean and Deschamps (1975: 162) concluded that pauses occurred more often in English than in French and were briefer, and pauses inside the verb phrase were more frequent in English than in French. Raupach (1980: 268) also suggested that pausing patterns in languages differ, and that learners transfer their pause pattern from L1 to L2.

No previous investigation has reported empirical results on pausing patterns and the speed of Modern Latvian (the Latvian language consultants from the Latvian Language Institute, 2012: personal communication). In an article on pausing patterns by Asher and Simpson (1994: 2550), it is stated that Latvian speakers normally pause after a group of several words; they may also hesitate within a word, but only when they are trying to find the right words to say next or when they are doubtful about something. However, it is difficult to say what exactly Asher and Simpson meant by "several words". According to a specialist in Latvian philology, teacher of Latvian as a Foreign Language and ex-worker of the Latvian Language Institute, Paukšte (2012: personal communication), Latvian is faster than English, as Latvians produce around 150–180 words per minute. In English the usual speaking rate is about 100 to 125 words per minute (Kelly and Watson, 1989: 210, see section 3.2), whereas 150 words per minute is considered to be a fairly high speed of delivery (Zybatow, 2010: 62, see section 3.2).

Concerning pausing patterns in Latvian, Paukšte (2012: personal communication) noted that normally logical pauses appear at the end of the sentences, between grammatical clauses and also in order to stress important information in a sentence. To achieve the latter goal speakers usually slow down. Paukšte (*ibid*.) conducted a study where she compared subjective impressions of the speed and pausing patterns of Latvian and English. Five Russians from remote places of the country who speak neither English nor Latvian were asked to listen to two extracts of English and Latvian colloquial speech of the same quality recorded by native speakers. It is worth mentioning that neither Latvian nor English is similar to Russian. All three languages belong to different language groups (English to Germanic, Latvian to Baltic and Russian to Slavic). All the five listeners concluded that they faced considerable difficulties in distinguishing where one sentence ended and the following one began in the English recording. The participants also found that the pauses in the Latvian recording were more tangible, apart from places where one sentence finished with a vowel and the next one started with a vowel. In this case pauses were not noticed.

The results of this study indicate that there are different pausing patterns in English and Latvian. The processes of speech reduction as well as shorter and less clear pauses in English may create particular difficulties for Latvian speakers when processing English rapid speech.

Elision

As I have mentioned in section 3.3, the only vowel which is frequently elided in English rapid colloquial speech is /ə/. When one syllable ends with a closing diphthong (/eɪ, aɪ, ɔɪ, əʊ, aʊ/) and the next syllable begins with a vowel, the second part of the diphthong may be elided.

Endzelīns (1971: 48–49) analysed contraction and elision in the Baltic languages, and came to the conclusion that in Latvian, as opposed to Lithuanian, elision is not encountered. Contraction of vowels in Latvian occurs only at the morphological boundaries of the elements of compounds mainly in etymologically unclear words, and in dialects (*ibid*.). Other sources provide information on elision in Latvian only in relation to Latvian folk songs (Katzenelenbogen and Manning, 1935: 116) or Latvian dialects (Lekomceva, 2007: 177).

The above observations indicate that elision is a rare phenomenon in Latvian, and Latvian listeners may therefore have problems connected with the elision of English /ə/ and the second part of a diphthong.

Assimilation

In English, the vowel /ɪ/ in the word *cre'ate* will undergo non-phonemic assimilation in fast colloquial speech (to /i/) as it is unstressed and placed in morpheme-final position. In Latvian in this case, it would never be assimilated, because in Latvian stress always falls on the first syllable, and stressed vowels do not go through assimilation (Hayes, 1995: 26). This example is just an illustration of the reduction process, but it will hardly cause any processing difficulties on the part of Latvian speakers. Even though there is a difference in vowel quality caused by non-phonemic assimilation, English /i/ will become closer to Latvian /i/ as a result of the change.

Assimilation in Latvian, as opposed to elision, is a regular process. It concerns mainly regressive voicing assimilation of consonants (Laua, 1997: 77–79). As a result of assimilation, the /v/ and /j/ consonants can be vocalized to /u/ and /i/ vowels, e.g. stāv /stāvēt/, /stāu/ (*ibid*.: 81–82). The first and the third types of processes of assimilation of English vowels described in section 3.4 pertain also to Latvian vowels: 1) if a vowel precedes a fortis obstruent like /s/ within the same syllable, it will be pronounced slightly shorter than usual; in case it precedes a lenis obstruent like /z/ within the same syllable, it will be pronounced slightly longer, and 2) when a nasal consonant occurs before or after a vowel, the part of the vowel closest to the nasal consonant is usually nasalized (*ibid*.).

Even though non-phonemic assimilation of vowels can make the meaning of a word ambiguous, Latvian pilots are unlikely to have perception problems connected with vowel assimilation. English vowels undergo only non-phonemic assimilation where there is no change in one of the distinctive features of a phoneme, and assimilation of English vowels is very similar to assimilation of Latvian vowels, with a few exceptions, namely the lack of assimilation in the first syllable and the lack of assimilation of /ʊ/ and /ɪ/ in particular contexts.

Liaison

I have not been able to find any research on the process of liaison in the available literature on Latvian phonetics, and, as I have already mentioned, it is not a process I am going to cover in this thesis.

Stress

In both English and Latvian, each word or phrase has a single strongest syllable. However, the rhythmic structure of these two languages is different. English is a stress-timed language employing stress rhythm, while Latvian is a syllable-timed language. As Bond, Markus and

Stockmal (2003: 529) rightly note, "stressed and unstressed vowels in languages employing stress rhythm vary widely in duration, whereas the durations of vowels in syllable rhythm languages vary less". One of the reasons could be that the speakers of stressed-timed languages are trying to even up the duration of the units between stresses by reducing some unstressed vowels. In English these unstressed vowels are usually /ə/ and /ɪ/ or /ʊ/ (Kess, 1992: 53). On the other hand, Latvian vowels also vary in duration. As I have already mentioned, Latvian vowels are also shortened before fortis obstruents and lengthened before lenis ones.

In stress-timed languages, there is a longer interval between vowels, and this interval is irregular, as these languages have a greater variability of syllable structures (Guasti, 2004: 35). Since there are few types of syllables in syllable-timed languages, the distance between vowels is not so long and more regular (*ibid*.). Such "varying" stress patterns and different rhythm create considerable difficulties for non-native listeners of English who have a syllable-timed L1.

The fact that Latvian stress is always fixed on the initial syllable also makes it difficult for Latvian listeners to perceive a language with variable stress, even though it is said to be predictable (see section 3.7).

4.2 Norwegian–English

Norwegian pilots might also have problems with the perception of English utterances produced by their native-speaking colleagues, though probably to a lesser extent than Latvian pilots (see the beginning of chapter 4). Norwegian pilots, as well as Latvian pilots, would presumably have problems with the perception of sounds that are significantly different from those in their mother tongue, and problems connected with the economy of energy by native speakers, which results in assimilation, elision or any other type of sound reduction.

The Norwegian language belongs to the North Germanic branch of the Indo-European language family, and is spoken by approximately 4. 5 million people (including both *bokmål* and *nynorsk*) (Žiūkaitė-Hansen, 2005: 9). Standard Eastern Norwegian (henceforth *SEN*) or *bokmål* (Vanvik, 1975: 9) is taken as my basis for analysis.

4.2.1 Problems with vowels

Norwegian enlists 19 monophthongal vowel phonemes, while English has 12. The Standard Norwegian vowel system is larger and more symmetrical than the RP vowel system (see figures 7, 8, 10 and 11). In the following section, I will explain the differences between the RP and

Norwegian phonemes, and predict the problems the pilots might face. I will also point out relevant differences between Norwegian and Latvian.

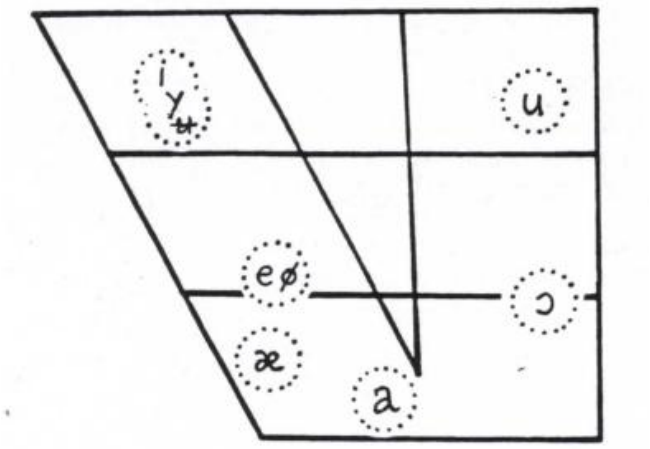


***Figure 7*, Eastern Norwegian short monophthongs (Bird, 2005: 33)**

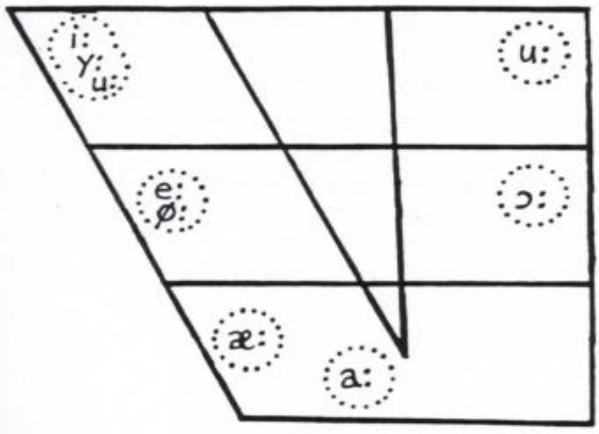


***Figure 8*, Eastern Norwegian long monophthongs (Bird, 2005: 33)**

Unrounded lips	Rounded lips
i(:), e(:), æ(:), a(:)	y(:), ø(:), ɔ(:), ʉ(:), u(:)

***Figure 9*, Eastern Norwegian monophthongs, position of the lips (Bird, 2005: 33)**

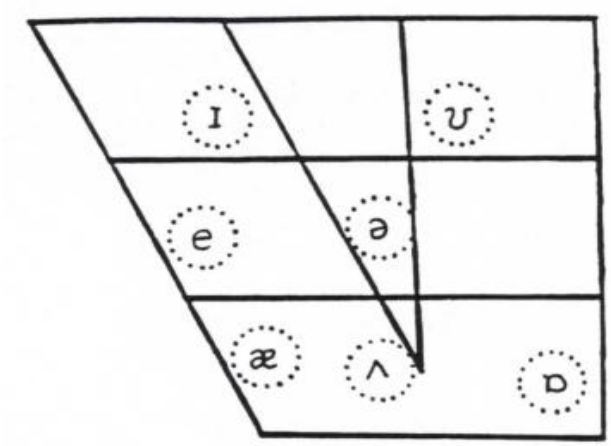


***Figure 10*, RP short monophthongs (Bird, 2005: 29)**

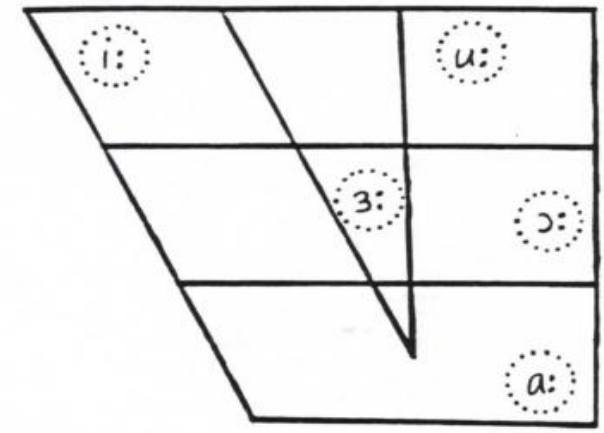


***Figure 11*, RP long monophthongs (Bird, 2005: 29)**

According to Vanvik, the former head of the Phonetics Department at the University of Oslo, (1975: 12), Norwegians have obvious difficulties producing the following RP vowel phonemes: /ɪ/, /ʊ/, /ɒ/, /ʌ/, /ɜ:/, but particularly /ɪ/, /ɒ/ and /ʊ/. It is worthy of note that the close front short (Norwegian /i/, English /ɪ/), close back short (Norwegian /u/, English /ʊ/), and open back short (Norwegian /ɔ/, English /ɒ/) vowel phonemes are present in both languages, but are articulated differently. In Vanvik's opinion, these three vowel phonemes create even more problems than the mid central long /ɜ:/, for which there is no Norwegian phoneme that overlaps to a similar degree. It is hypothesized that Norwegians might have difficulties not only with producing these vowels, but also with perceiving them.

In this chapter I will frequently refer to Nilsen (2010) and Vanvik (1975). Even though these scholars mostly speak about production, rather than perception, they do compare Norwegian and English sounds. As non-native speech perception is believed to be influenced by

the learners' L1 (see section 2.3), I found their observations relevant to the current study. The field of the perception of specific English sounds by Latvians and Norwegians seems to be underresearched.

As mentioned above, Norwegian has the close front short /i/ (e.g. Norwegian *å minne* (to remind)), but it is somewhat different from its English counterpart (Vanvik, 1983: 24). The English /ɪ/ is considerably more open and more retracted (Vanvik, 1975: 14). "To a Norwegian ear it may be rather *e*-like, although clearly different from the Norwegian /e/" (*ibid*.: 15). Norwegian short /i/ is fully front and very close to the quality of /i:/, that is why the Norwegian learners risk mixing up English /ɪ/ and /i:/ when producing it. According to Nilsen (2010: 105), English listeners may have difficulties distinguishing between the Norwegian production of *live* and *leave*: "it can have drastic consequences for a possible friendship in a sentence like *I hope you won't leave/live*" (*ibid*.). If we compare these two phonemes with the Latvian /i/, we will see that the Latvian sound is much closer and front than both the English and Norwegian sound. Both the Latvian and the Norwegian sounds are closer to the English long /i:/ than to its short variant. The RP /ɪ/ is not the same as the Norwegian /i/, but the Latvian counterpart is even more different. This means that Latvians, probably, might have more problems with the perception of the RP /ɪ/ than the Norwegians.

The close front long /i:/ is sometimes diphthongized from a lower position towards a closer position in English (Vanvik, 1975: 14). In Norwegian, on the contrary, the /i:/ is diphthongized in the opposite direction, i.e. towards a centring diphthong ending in /ə/ (e.g. Norwegian *fin* (fine)) (*ibid*.). But there is only a slight difference, and it is unlikely to affect the perception of this phoneme. The Latvian /i:/ is a little bit more front than both the English and Norwegian phonemes, and, like the Norwegian sound, a little bit closer than the English counterpart. Again, it seems that the Latvian sound is not as close to the target RP phoneme as the Norwegian one.

The Norwegian close back short /u/ (e.g. Norwegian *loff* (white loaf of bread)) is said to have a fair resemblance to the American English pronunciation of /ʊ/ (Halvorsen, 1984: 68). Vanvik (1975: 18) considers that the RP /ʊ/ is far from both Norwegian /u/ and /ʉ/ (e.g. Norwegian *å putte* (to put)), as the RP variant has a very relaxed articulation. However, Nilsen states that the most common Norwegian mistake is to use the short /ʉ/ sound, which is a front vowel with extra strong lip-rounding, instead of English /ʊ/ (Nilsen, 2010: 118). In this case we see that Norwegians would use not the sound actually closest to the target, but the one that would

be used in Norwegian if the word was spelled the same way. Speaking about the Latvian /u/, it is almost of the same quality as the Norwegian /u/, but closer. Thus, it is even further from the RP variant than the Norwegian phoneme.

The RP close back long /u:/ lies between the Norwegian /u:/ and /ʉ:/, but closer to the Norwegian /u:/ (e.g. Norwegian *mor* (mother)). The "advanced" allophone of /u:/ in words where *j* comes right before this sound (e.g. *music* /mju:zik/, tube /tju:b/) is almost as advanced as the Norwegian /ʉ/ (Popperwell, 2010: 29; Vanvik, 1975: 19). The Norwegian and Latvian /u:/ are almost identical.

The lip-opening is larger for the RP open back short /ɒ/ than for Norwegian /ɔ/ (e.g. Norwegian *å måtte* (must)) (Popperwell, 2010: 26). That is why Norwegians do not open the mouth wide enough when pronouncing this sound. "When /ɒ/ is preceded by the semi-vowel /w/, many Norwegian learners tend to use /ɔ:/ instead of /ɒ/, thus failing to distinguish between *was* and *wars*" (Nilsen, 2010: 116). Whereas the Norwegian /ɔ/ is closer than the English /ɒ/, the Latvian /ɔ/ is even closer than the Norwegian one. This means that it might be more problematic for Latvians than for Norwegians.

The RP /ɔ:/ is a mid back long sound. Vanvik (1975: 18) defines this sound as identical with the Norwegian /ɔ:/ (e.g. Norwegian *lås* (lock)). Bird (2005: 29, 33) places it a little bit lower than the Norwegian phoneme in the cardinal vowel diagram, which means that the Norwegian sound is a little bit closer. Whoever is more precise in their definition, this sound does not seem to create many problems for Norwegian listeners. The Latvian phoneme is very similar to the Norwegian and RP /ɔ:/.

When pronouncing the English /ʌ/, which overlaps with the Norwegian /a/ (e.g. Norwegian *makt* (power)), Norwegians are apt to round their lips and produce the Norwegian *ø*-sound, which is not present in English (Vanvik, 1975: 16). Here we see a similar tendency as with the RP /ʊ/: Norwegians do not use the sound closest to the RP variant. However, the presence or absence of cognates seem to play a role. Norwegians do not usually use /ø/ in cognate words which do not have /ø/ in the Norwegian variant, e.g. *to come* (å komme), but rather use the Norwegian pronunciation of the vowel. The Latvian /a/ is as open as the Norwegian /a/, and hence a little bit more open than the RP /ʌ/.

The RP /ɑ:/ is a back sound, while its Norwegian counterpart /a:/ is a central sound (e.g. Norwegian *far* (father)). The Latvian /a:/ is close to the Norwegian sound, and thus also more front than the RP variant.

The mid central long vowel phoneme /ɜ:/ does not have a clear counterpart in Norwegian. Norwegians are believed to have the same problem with this sound as with the sound /ʌ/, as they tend to round the lips and produce the *ø*-sound instead (Vanvik, 1975: 19). As we have seen, Latvian does not have a mid central long vowel phoneme either.

As for the mid central short vowel phoneme /ə/, also called the schwa, some linguists (e.g. Popperwell, 2010: 12–13; Vanvik, 1983: 26), as opposed to Bird (2005: 33), consider that Norwegian has this sound (e.g. Norwegian *gat̲e* (street)). The reason is that unstressed Norwegian /e/ is more central than the stressed variant. However, it is not quite as central as the English /ə/. There is no schwa in Latvian.

While Vanvik (1975: 15) says that the RP /e/ is practically identical with Eastern Norwegian /e/, Bird's (2005: 29, 33) vowel diagrams show that the RP phoneme is more front and closer than the Norwegian one (e.g. Norwegian *lett* (light)). The Latvian /e/ is even more front and closer than RP /e/, and it differs slightly more from the RP /e/ than does the Norwegian phoneme.

The RP /æ/ is a little below half-open, front and short. However, except before voiceless consonants, it is often phonetically long. This phoneme is similar to the Norwegian /æ/ (e.g. Norwegian *vært* (been)). According to Vanvik (1975: 16), many Norwegians tend to use /e/ instead of /æ/ in English, because the Norwegian /æ/ occurs chiefly before /r/ and retroflex consonants. The Latvian counterpart is closer and more central than the Norwegian and RP /æ/. That is why it is less similar to the RP phoneme than the Norwegian sound.

What can be seen from the comparison of the three sound systems is that the Latvian vowel phonemes are generally less similar to the target RP sounds than the Norwegian vowel phonemes (the only exception is the Latvian /a/). Apart from that, the Norwegian short vowels generally look more central than the Latvian ones (however, this is not true of the Latvian /æ/ and /a/). It appears that the position of /e/, /æ/, and /æ:/ is one of the major differences between Latvian and Norwegian, and this could mean that Latvian and Norwegian pilots might mix them up with different phonemes. The differences are shown in figure 12 below.

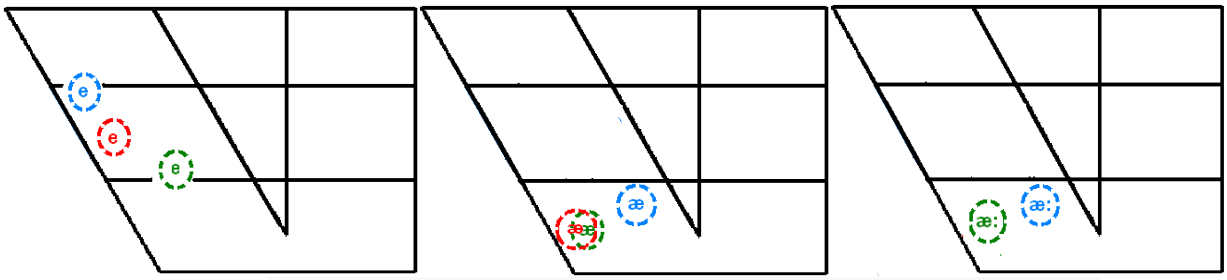


***Figure 12*, /e/, /æ/, and /æ:/ in Latvian (blue), Norwegian (green) and RP (red)**

There are five diphthongs in Norwegian, whereas there are eight diphthongs in RP (see figures 13, 14, 15 and 16). Vanvik (1975: 22) provides the comparison of RP and SEN (bokmål) diphthongs shown in figure 13, where he shows which diphthongs are similar to each other, and which ones do not have a clear counterpart.

RP	eɪ	əʊ	aɪ	aʊ	ɔɪ		ɪə	eə	ʊə
SEN	æi	æʉ	ai		ɔy	øy			

***Figure 13*, The diphthong phonemes of RP and Standard Eastern Norwegian (Vanvik, 1975: 22)**

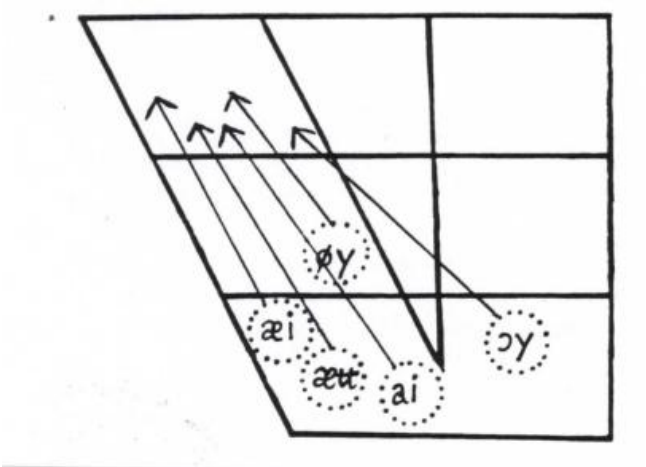


***Figure 14*, Eastern Norwegian diphthongs (Bird, 2005: 33)**

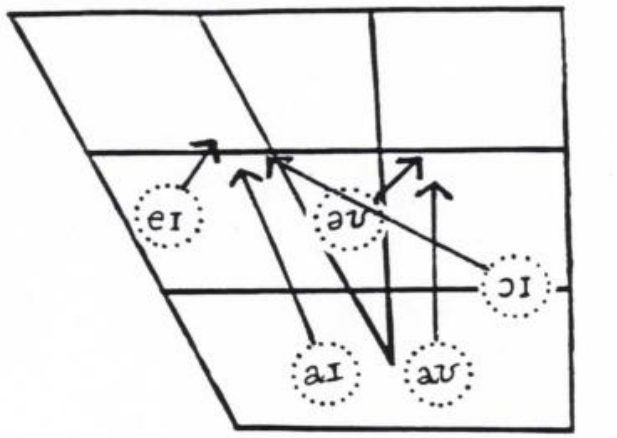


Figure 15, **RP closing diphthongs (Bird, 2005: 30)**

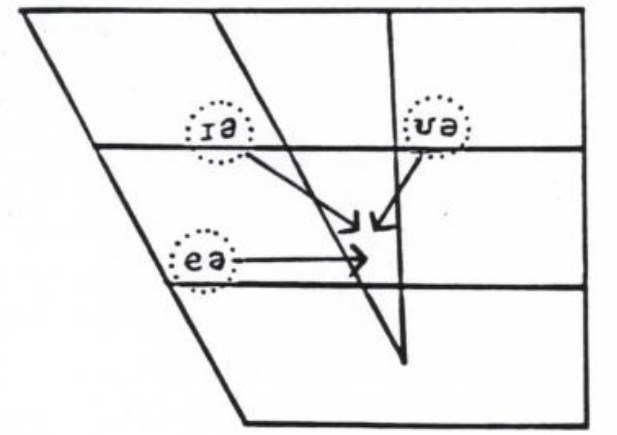


Figure 16, **RP centring diphthongs (Bird, 2005: 30)**

While Vanvik (1975: 22) says that there are four diphthongs which Norwegian does not have, namely /aʊ/, /ɪə/, /eə/ and /ʊə/, Hughes, Trudgill and Watt (2005: 50) argue that there are only three diphthongs not present in Norwegian, /ɪə/, /eə/ and /ʊə/. These diphthongs are *centring* diphthongs, i.e. having schwa as the second element (*ibid*.). All the Norwegian diphthongs (as well as the other five English diphthongs) are *closing* diphthongs, that is, having a closer second element than the first (*ibid*.). Vanvik (1975: 26) notes that the RP centring diphthong /ɪə/ is often perceived as /eə/ by Norwegian ears. According to Vanvik (*ibid*.), Norwegians tend to use Norwegian /e:/ or /æ:/ as a starting point for English /eə/, and replace English /ʊə/ with the Norwegian sound /ɔ:/, which is practically identical in English and Norwegian. However, there are several alternative counterparts for the RP diphthong /ʊə/ in Norwegian. Dirdal, associate professor of English at the University of Oslo and a native speaker of Norwegian, (2012: personal communication) says that Norwegians often replace the /ʊə/ with the Norwegian phoneme /ʉ/, but sometimes also use the sound /ɔ:/ mentioned by Vanvik, that may even be used

by native speakers, for example in *tour* or *secure*. Stenbrenden, assistant professor of English at the University of Oslo and a specialist in English phonetics, (2012: personal communication) notes that the /ʊə/ is replaced with the /ɔ:/ in the speech of young native speakers of English. It is a question whether it would be difficult for Norwegians not only to produce, but also to perceive these sounds.

In comparison to Latvian pilots, Norwegian pilots are expected to have fewer problems with the English diphthongs, as they are used to the weakening of the second diphthong element.

4.2.2 Problems with vowels in connected speech

Both English and Norwegian belong to the Germanic branch of the Indo-European language family. The shared history of these two languages accounts for many similarities. Both languages undergo reduction processes in connected speech and have similar intonation patterns.

The speed of speech

As has already been stated in a previous section (3.2), English speakers tend to utter around 100 to 125 words per minute (Kelly and Watson, 1989: 210). According to Hilton, Schüppert and Gooskens (2011: 220), there had been just one quantitative study of speech and articulation rates in Norwegian, conducted by Almberg (2000), before they carried out their own research. Almberg (*ibid*.: 66) concluded that longer utterances were produced at higher articulation rates, which is not a new finding (see section 3.2), and that the articulation rate in Norwegian is between 3.6 and 4.4 syllables per second. The results of Hilton, Schüppert and Gooskens' study (2011: 231) show the same rate of speech delivery, even though the method was different. Unfortunately, there are no available results on the speed of speech in Norwegian counted in words per minute. In order to compare these two languages, I turned to a study by Field (2003: 36) for a typical articulation rate in English, which is said to be between 4.4 and 5.9 syllables a second. Syllables a second is a more accurate calculation, as words can vary in length; however, I have not been able to find much research about it. If we compare the articulation rates of English and Norwegian, it seems that English is typically spoken faster than Norwegian.

However, it is also important to take into account that there is a difference between phonetic and phonological syllables. Phonetic syllables are actually produced syllables. Phonological syllables are canonical syllables. For instance, the Scandinavian languages exhibit differences in their degree of reduction in rapid speech (Danish containing more reduction than

Norwegian and Swedish), but the number of phonetic syllables produced per time unit does not differ significantly (Hilton *et al*., 2011: 232). Such differences in the production of phonetic and phonological syllables may also pertain to English and Norwegian.

Elision

Elision is a kind of economy of articulation where one or several sounds are omitted. Many English consonants and several vowels undergo this process of reduction (see section 3.3). Elision is also encountered in Norwegian. A number of Norwegian consonants go through elision (Hilton *et al*., 2011: 217; Vanvik, 1983: 45).

Norwegian, as well as English, has elision of /ə/.

In Norwegian, elision also affects vowels by reducing not only separate sounds, but often entire syllables. Norwegian elision sometimes involves such processes as apocope, syncope (in Norwegian dialects, this is of less relevance for the current study), and often haplology (also in SEN; Hilton *et al*., 2011: 230; Husby *et al*., 2008: 27; Vanvik, 1983: 45). Haplology is a reduction process whereby two identical elements occurring in a sequence are reduced to one (Coppen *et al*., 1998: 156). Examples of this type of elision in Norwegian are as follows: *filologi* ("philology") – *filogi*, *kunststykke* ("feat") – *kunstykke*, *poststempel* ("postmark") – *postempel*, *øststatene* ("Eastern states") – *østatene*, etc.

In a study of the reduction of Norwegian speech, Hilton, Schüppert and Gooskens (2011: 226) calculated the reduction ratio by subtracting the number of phonetic syllables from the number of phonological syllables. The outcome showed that the difference between the number of phonological and phonetic syllables counted in two types of recordings was not the same. A faster syllable rate was produced in a radio news broadcasts (NRK) than in a set of semantically unpredictable sentences (see appendix 2, *ibid*.).

All in all, elision is not an unknown process for the Norwegian ear. Even though the process in Norwegian functions in a different way, Norwegian listeners are more used to speech reduction than Latvian listeners.

Allophonic variation

Assimilation makes one sound become similar to another. A number of Norwegian consonants undergo this process (Hilton *et al*., 2011: 217; Vanvik, 1983: 44). Norwegian vowels do not go through assimilation, but exhibit allophonic variation; e.g. when a vowel is followed by a fortis

obstruent, it becomes shorter, when it is followed by a lenis obstruent, it is pronounced longer than usual (see section 3.4).

Allophonic variation in English vowels is not likely to cause problems for Norwegian listeners, as allophonic variation does not change the distinctive features of a phoneme, and it occurs in their L1 also.

Stress patterns and tones

Norwegian, as well as English, has a distinctive word-stress manifested phonetically (inter alia) by pitch (Borgstrøm, 1938: 191, cited in Liberman, 1982: 30). Norwegian is also a stress-timed language and stress is variable in Norwegian, though it is grammatically predictable from its synchronic morphological organization (Haugen, 1967, cited in Beckman, 1986: 41). Norwegian stress is culminative at the word level.

Unlike English and all other Germanic languages except Swedish, a difference in word tone may distinguish meanings in Norwegian in words of more than one syllable (Hallaråker, 1983: 22; Vanvik, 1983: 42–44), e.g. *landet* ("the country") – *å lande* ("to land"), *suset* (the murmur) – *å suse* ("to sough"), *bønder* ("farmers") – *bønner* ("beans"), *tømmer* ("tree") – *tømmer* ("harness"), etc.

Probably an unusual melody of speech may create some problems for Norwegian listeners, but to a smaller extent than for Latvian listeners. One of the advantages for Norwegian listeners, as opposed to Latvian listeners, is that the two Germanic languages have the same rhythmic structure, and the fact that in Norwegian, as well as in English, stress is variable (not fixed on the first syllable, as it is in Latvian). Furthermore, I suppose that due to the presence of tonemes which help to distinguish meanings between words in Norwegian, Norwegian listeners may be more sensitive than Latvians towards stress and pitch patterns in a language.

5 Previous research on L2 speech comprehension in an aviation context & phonetics and listening activities presented in textbooks for pilots

In this chapter I will briefly describe Language Proficiency Requirements for pilots (and controllers) designed by the ICAO in order to give an overview of the basic international standards. Further I will review the findings of several studies of L2 speech comprehension by pilots and controllers. Then I will look into the phonetics and listening activities presented in a textbook for pilots, *Aviation English* by Kennedy (2008), and in an Internet-based English language training programme, *Climb Level 4*, worked out by Mayflower College experts (Mayflower College, 2012a). I chose these materials as they are based on ICAO document 9835: *Manual on the Implementation of ICAO Language Proficiency Requirements* (2004). These materials have been carefully designed to help students achieve and maintain a Level 4 according to ICAO language requirements (see ICAO Language Proficiency Requirements in section 5.1), and to help students develop the specific skills described in the ICAO Language Profile (see appendix 3).

I will look at the findings of previous studies of the perception difficulties of non-native speakers and at the phonetics introduced in textbooks for pilots, in an attempt to infer which problems Latvian and Norwegian pilots may face when communicating with native-speaking controllers.

5.1 ICAO Language Proficiency Requirements

Following a number of accidents caused by language misunderstandings (see Introduction), ICAO set an agreed standard of English for pilots and controllers worldwide in March 2008. The standard is applicable to both native and non-native speakers of English in 190 states, including Latvia and Norway (ICAO News Release, 2011).

Aeronautical subject matter experts and language teachers (namely, "operational and linguistic experts with backgrounds in aviation (pilots, controllers, and civil aviation authority representatives) or Aviation English training and applied linguistics, representing Contracting States and international organizations covering most main linguistic areas") used their

experience and expertise to achieve the most accurate requirements (ICAO, Manual on the Implementation of ICAO Language Proficiency Requirements, Doc 9835 AN/453, 2004: 1.1.6).

The Standard requires both ICAO Standard Phraseology and plain language (*ibid*.: ix). Plain language is "focused on aviation-specific topics, which are believed to be more efficient than general English" (*ibid*.: 4.4.3).

The document comprises requirements with regard to speaking and listening skills only, while reading and writing skills are not considered to be important for aeronautical communication. Speaking and listening skills are assessed according to the ICAO Language Proficiency Rating Scale, which consists of six levels of language proficiency (see appendix 3). Operational Level 4 is the minimum required proficiency level for pilots and controllers (*ibid*.: A-9).

As mentioned, the ICAO Language Proficiency Requirements also concern native speakers of English, as it is extremely important to ensure that their speech is not too fast, and is distinct and clear for non-native speakers of English (*ibid*.: 3.8.2).

Despite the fact that there is a common standard for language proficiency requirements applicable to all ICAO member states, there is no single uniform examination which would test whether pilots (and controllers) meet these requirements or not. "While the ICAO language proficiency requirements establish testing requirements, the development of tests and testing procedures is left to states, airlines, and training organizations, while the State Aviation Authorities maintain oversight responsibility" (*ibid*.: 6.1.3). The lack of a uniform examination may lead to inadequate assessment of pilots' English language proficiency in some countries.

5.2 Previous research on L2 speech comprehension in an aviation context

The problems which pilots face when perceiving the speech of their native-speaking colleagues are connected with L2 speech comprehension in general. There are several previous studies on L2 speech comprehension in aeronautical communication which indicate a considerable difference between L1 and L2 perception.

Borchgrevink (1981: 22–32) studied L2 speech comprehension in noise on the instructions of the Institute of Aviation Medicine in Oslo, Norway. English–Norwegian bilingual adults with English or Norwegian as their L1 were presented with recordings of simple English and Norwegian sentences. Each sentence was first presented in so strong background noise that it

could not be perceived, and was repeated with the noise level progressively reduced until the sentence was repeated by the listener. The results demonstrated a significant difference between the L1 comprehension threshold and the L2 comprehension threshold. The native language sentences were correctly repeated at a lower signal-to-noise ratio than the L2 sentences for both the English and Norwegian groups of listeners.

A similar study on the effects of time-compressed speech on native and EFL listening comprehension in aural communication in aviation was conducted by Bond, Moore and Gable (1996: 2510–2513). The task of the listeners, native and non-native speakers of English, was to identify English words and sentences, and to use their linguistic knowledge to respond to the heard information. The recordings were mixed with noise. Native speakers performed better than non-native speakers (with a good command of English), who required full specification of the acoustic-phonetic information relevant for selecting a particular word. Native speakers employed a top-down process to process recorded information, i.e. their knowledge of the context affected their perception of individual sounds (which were not discernible due to background interferences), while non-native speakers used a bottom-up process, i.e. they composed the whole picture from the individual sounds (*ibid*.: 2513). Research by ICAO experts (ICAO, Manual on the Implementation of ICAO Language Proficiency Requirements, Doc 9835 AN/453, 2004: 3.7.1) has also shown that non-native speakers of English rely much more heavily on pronunciation, rather than context, to understand spoken messages.

Kim and Elder's (2009: 23.1–23.17) research in radiotelephony communication is also relevant to the present study. It emphasizes the difficulties non-native speakers have when communicating with their native-speaking colleagues. Kim and Elder studied factors which contributed to miscommunication in emergency situations in the Korean air space. The data for the study were collected in Incheon International Airport. The researchers requested recordings of non-routine communication, transcribed them and studied the nature of the misunderstandings together with eight aviation experts. Among the six non-routine situations transcribed by the researchers, there was a conversation between an American pilot and a Korean controller. The topic discussed was diversion to an alternative airport due to fuel shortage (see transcription in appendix 4). The problem was that the Korean controller did not understand the reason why the American pilot wanted to divert to the other airport and misunderstood a requested destination due to verbosity, inappropriate word choice and pronunciation "typical of native-speaking

aviation personnel". After some time the controller failed to understand that there was a second change in the airport destination. Aviation experts who studied this case accused the native-speaking pilot of not using standard phraseology and of inability to employ accommodation strategies required for successful interaction between interlocutors of different English language proficiency. For instance, the experts noted that the American pilot started his request with the utterance "due to operational requirement …" instead of defining the problem: "request divert to Shanghai". Kim and Elder (2009: 23.14) argued that the native speakers had a tendency to use "more complex syntax and vague or non-standard terminology" when speaking to their colleagues irrespectively of their language background. Surprisingly, only one pilot from the group of eight aeronautical experts and the two researchers blamed the controller for miscommunication, while the rest accused the American pilot of providing redundant information, and even the ICAO language testing policy of being focused only on non-native English speaking pilots and controllers.

However, not all researchers have found that language background is one of the determining factors in whether pilots experience communication difficulties. Estival and Molesworth (2009: 24.1–24.16 cited in Read and Knoch, 2009: 21.7) investigated elicited self-report data from English native-speaking and non-native-speaking pilots on their difficulties in communication with controllers in Sydney Airport. The results of their study indicate that pilots found it challenging to communicate by radio with controllers regardless of whether they were L2 users or native speakers, as they frequently had to repeat information or ask controllers to repeat the intended message.

Cookson (2009: 22.1) studied two widely discussed aviation disasters, caused partly by miscommunication between pilots and controllers, where, in both cases, one of the parties was a native speaker of English and the other one was not, namely the mid-air collision above Zagreb in 1976 (176 deaths) and the runway collision at Tenerife in 1977 (583 deaths). In the first case, the controller most probably unintentionally switched from English to Serbo-Croatian (his L1) throughout the exchange of the messages with Inex-Adria Airways Flight 550, which were transmitted also to the British Airways Flight 476 cockpit and played a decisive role in the aircraft collision, since it was reported that the two aircraft were at the same altitude. According to some experts, the British Airways crew might have prevented the collision if the messages had been transmitted in English (Beaty, 1995: 42); according to others, there may not have been

enough time for the pilots to take avoiding action (Air Accidents Investigation Branch, Aircraft Accident Report 5/77, 1977: 37).

The second case studied by the researcher is more relevant to the present study. In this case Cookson looked into the biggest accident in aviation history – when KLM Flight 4805 collided with Pan American Flight 1736 in Los Rodeos Airport on the island of Tenerife. This accident was caused by a combination of factors. In the present context, I will mention only one factor – the miscommunication between the Pan American crew and a Spanish controller. It was the first time that this Pan American crew taxied in this airport; due to a bomb explosion in Las Palmas Airport they had been redirected to Los Rodeos. A report conducted by the Airline Pilot Association (Roitsch *et al*., 1978: 11) demonstrated that the Pan American crew (who were native English speakers) found it difficult to communicate with the Spanish controller. The Spanish controller told Pan American to leave the runway taking the third exit to their left. However, the third exit had two turns. Due to "a practical impossibility" to negotiate with the controller, Pan American decided not to discuss it, and continued towards the fourth exit (*ibid*.: 19).

At the end of his study, Cookson (2009: 22.12) suggested that language awareness training be given to native-speaking pilots and controllers engaged in communications with non-native speakers of English in order to teach them to express information more efficiently and more intelligibly.

The disasters discussed in these studies are unfortunately not the only ones which have happened due to miscommunication between non-native speakers of English and their native-speaking colleagues. There are a number of examples of this kind. In 2007, a Chinese pilot landing at New York's JFK International Airport failed to understand the native-English-speaking controller, who was said to have demonstrated a lack of sensitivity to the Chinese pilot's language problems (Alderson, 2009: 170). In 1995, an American Airlines plane flew into a mountain in Columbia and crashed (160 deaths), and the controller complained that he did not have adequate English language skills to understand the problem of the American crew (Aiguo, 2005: 66). More examples could be added.

The results of the previous studies indicate that pilots face problems when perceiving the speech of their native-speaking colleagues. First, it is more difficult to perceive L2 speech than L1 speech when it is mixed with background noises and interferences, which constitute an

integral part of aeronautical radiotelephony communication. Secondly, native speakers often fail to accommodate to the more limited language proficiency of their L2 interlocutors and do not eliminate complex expressions from their speech.

There has been research on L1 and L2 perception in aviation, but based mainly on the perception of speech affected by noise. I have not been able to find any previous studies on the perception of specific language sounds and language pairs by pilots or controllers. I will describe my own study on these issues in the practical part of the thesis.

5.3 Phonetics and listening activities presented in textbooks for pilots

In this section I will describe phonetics and listening activities from *Aviation English* by Kennedy (2008) and from the Internet-based English language assessment and training programme *Climb Level 4* (Mayflower College, 2012a). At the end of the section, I will summarize my observations on how much information on phonetics and listening activities these educational materials contain, and what kind of information it is.

***Aviation English* by Kennedy (2008)**

This book was specifically designed to help pilots and controllers achieve and maintain ICAO Level 4. The author of the book, Kennedy, is responsible for the Ecole Nationale de l'Aviation Civile (ENAC) English language-testing programme and for an English language-training programme for pilots.

The book attempts to foresee the most likely non-routine situations in aviation. The chapters touch upon such topics as *runway incursions* (i.e. "the unauthorized entry onto a runway by an aircraft, a vehicle, a person, an object" (Kennedy, 2008: 9)), dangerous for any taking off or landing; *being lost* (for example being blown off course by wind, etc); *technology*; *animals* (i.e. animal hazards in aviation; for instance, birds causing damage to a part of the aircraft or a lion escaping from a cage in the hold); *gravity* (i.e. loss of hydraulic power); *health*; *fire*; *meteorology*; *landing*; *fuel*; *pressure* (i.e. incidents of sudden decompression); *security* (e.g. suspicious passengers).

Theory and exercises on phonetics are presented at the end of each chapter. The author makes pilots familiar with the concept of word stress (p. 13). Students are asked to demonstrate the position of stress in words standing for letters in the ICAO alphabet. Much attention is also devoted to primary and secondary word stress (words with four or more syllables in English usually have both primary and secondary stress; pp. 53, 123), tonic stress (when one puts extra

strong stress on words to show a special focus; pp. 55, 115) and sentence stress (pp. 35, 45). The book draws teachers' attention to pausing patterns (p. 125), information groups (p. 125) and intonation. The teacher should ask pilots and controllers to identify how a speaker's voice rises and falls and to mark intonation in given sentences (pp. 66, 73). There is an activity which raises awareness of how native speakers of English join words together. This activity is meant to help students in their comprehension of natural speech (p. 43).

The chapters of the book provide more information on consonants than on vowels. This is understandable, as there are more consonants than vowels in English. The author emphasizes the distinction between /p/ and /b/ (p. 33), /l/ and /r/ (p. 75), and /ʃ/, /ʒ/, /tʃ/ and /dʒ/ (p. 85). The teacher is asked to make sure that all students can hear and reproduce the *–ed* past endings, because these create difficulties for many nationalities. The teacher should ask students to decide which groups of verbs get -/t/, -/d/ or -/ɪd/ (p. 23). The teacher should pay attention to how students pronounce *-tion*, *-cion* and *-sion* endings (p. 123) and various consonant clusters in separate words and phrases (p. 93).

There are two activities on vowels in *Aviation English*. In the first activity the teacher should check if students can hear the difference between the long and short vowel sounds (p. 105). The second activity is on diphthongs. Students are presented with a table of seven columns, each column labelled with a diphthong: /eɪ/, /aɪ/, /aʊ/, /ɔɪ/, /ɪə/, /əʊ/ and /ʊə/. (The diphthong /eə/ is not in the table). Students are asked to listen to words containing diphthongs and place them in the correct columns (p. 113).

The book comprises a sequence of listening activities, so that pilots have an opportunity to practice perceiving the speech of their colleagues. In some activities students listen to scripts which contain information about non-standard situations and should choose a description of or title for each situation from all the situations presented in the student's book (pp. 12, 22–23, 25, 33–35, 43, 52, 75, 83–84, 94, 104, 112). In other activities students listen to the script and are asked to mark what happened in a diagram or a table (e.g. to mark the pilot's path on the map (p. 25) or on the picture of a runway (pp. 14–15, 82). Students are also frequently asked to listen to tape recordings and to answer questions from the student's book, or to decide whether given statements are true or false (pp. 24, 32–33, 44, 84, 92, 103, 114–115, 123–124). Another task is to remember information presented in a recording (e.g. advice given in the recording (p. 63) or symptoms mentioned in the dialogue (p. 64)) and write a summary (p. 113).

As it is extremely important to perceive numbers, call signs (e.g. CZ310, HY5571), directions and co-ordinates (e.g. north, south-east, 274º) correctly in pilots' and controllers' jobs, there is a number of listening activities where pilots and controllers are asked to listen to and repeat directions and co-ordinates (p. 23), to put down the numbers they hear (p. 53), and to choose the mentioned call signs from all the call signs presented in the student's book (p. 15).

Only in one type of activity do students listen to their non-native peers, namely when discussing topics in groups (e.g. one of the topics is: "Americans are sometimes criticized for not making enough effort to adjust their rate of speech, to use standardized expressions or to moderate their regional accents in order to be easily understood by the international aviation community" (Kennedy, 2008: 11; pp. 27, 34, 47, 67, 107)).

All in all, phonetics constitutes a considerable part of the book's content. Activities on consonants, vowels, diphthongs and reduction processes which happen in fast connected speech are included in the book. Regarding pronunciation, the book states that it "needs to be sufficiently clear and intelligible to the international aviation community" (*ibid*.: 4). It is stressed that comprehension is of fundamental importance for pilots and controllers, both in routine and emergency situations. Kennedy (*ibid*.: 5) rightly notes that neither pilots nor controllers deal with non-routine situations on a daily basis, which means that they do not listen to English regularly and have little opportunity to practice their skills.

The English language assessment and training programme *Climb Level 4*

The Internet-based English language assessment and training programme *Climb Level 4* (Mayflower College, 2012a) is developed by Mayflower College specialists for pilots and controllers whose level of English is ICAO level 3 or 4 and who wish to improve it to ICAO level 4 or 5 (see description of ICAO levels in appendix 3). Mayflower College has been involved in Aviation English since 1992, providing general and aviation-specific courses to pilots and controllers, and it has designed the Test of English for Aviation (TEA) according to recommendations made in ICAO document 9835 (Mayflower College brochure: English for Pilots and Air Traffic Controllers, 2012b: 2–4).

Climb Level 4 has nine modules, and the topics of these modules are similar to those in *Aviation English*: *time, duration, schedules and fuel*; *health*; *people*; *weather*; *technology*; *aerodromes*; *cargo, materials and fire*; *communication*; *navigation, movement and geography*.

Each module contains *listening* and *fluency & interactions* parts.

The recordings for the listening activities are made by both native and non-native speakers, so that students may listen to a variety of international accents. There are more than 600 listening exercises in the *Climb Level 4* programme. Listening exercises include RTF messages (i.e. standard radiotelephony phraseology) between pilots and controllers, aviation news stories, and flight school programmes about air safety. Each audio recording has different exercises to help students understand more. For example, there are exercises where students must choose a sentence which contains the same information as the recording, put the information on the screen in the right sequence, decide if the information on their screen is *true* or *false* according to what they hear, or listen and then record what they hear. In the last listening exercise of each module students can see the transcript as they listen, and click on each word to see its meaning.

In addition to the nine modules, this Internet-based programme allows students to listen to British and American English pronunciation in the section *My Pronunciation Training*. Students have the opportunity to listen to separate sounds, and to follow how these sounds behave in words, phrases, sentences and connected speech. Students' attention is specially drawn to the concept of word stress. It is also possible to compare written and spoken language. Students can use the *Speaking Professor* to convert written language to spoken language even in grammar exercises, and to change the *Speaking Professor's* voice from male to female and from British English to American English. Furthermore, students have the opportunity to type or copy any English text they like and listen to it spoken in British, American, Australian, South African, Scottish, Irish or Indian male or female accents at a slow, normal or fast speech rate. Using the latest techniques in Speech Recognition technology, the *Intelligent Tutor* analyses students' performances, assesses their pronunciation and defines their problems (however, this concerns just speaking, not listening). For instance, students can practice the British pronunciation of the *ng* sound. Students may click the *Model Speaker* to hear the correct pronunciation and then record themselves. Green letters indicate a correct pronunciation and red letters indicate an incorrect pronunciation. In the *Feedback–Fluency* section students' speech rate is automatically counted in words per minute. In the *Results* section students can register their performance in order to compare their achievements.

Climb Level 4 is, undoubtedly, a programme which employs the latest techniques to teach speech production and recognition. The programme may detect pilots' and controllers' individual

problems in speech production, namely the pronunciation of certain sounds and longer language units, as well as too slow or too fast speech delivery. When students produce incorrect utterances, a red button starts to blink indicating their mistake. However, there are no such detection techniques with regard to listening. Unfortunately, there is no button which would start to blink if the student misunderstood any of the recorded sounds. The programme cannot detect whether the whole point of the longer utterance was misunderstood due to problems with the perception of certain sounds, intonation, or reduction processes, or to any other reason.

These two materials, *Aviation English* and *Climb Level 4*, do not differentiate pilots' nationalities, and do not look into the problems of a particular language group. Both of these sources are global course materials on English language teaching. Gray (2001: 119) accuses the content of such materials of being determined by the publishers' need to maximize sales, and the choice of topics of being fairly bland. The idea is that these materials are sold internationally, and there is no financial incentive to produce materials for the needs of local markets with the supplements by local authors with specific local knowledge.

6 Purpose of research, hypotheses and research questions

In this chapter I will repeat the purpose of this study and try to predict which vowels might be the most difficult to perceive for Latvian and Norwegian speakers of English.

6.1 Purpose of research

As stated in the introduction, the purpose of this study is to identify problems Latvian and Norwegian pilots face when perceiving the speech of their native-speaking colleagues. This knowledge can be used by those who supplement or design the curriculum for Latvian and Norwegian pilots. New exercises on the particular problems typical of each group of pilots can be introduced. In the present study I want to find out whether the identified problems are different for Latvian and Norwegian pilots and whether they primarily depend on the pilots' L1 influence, or whether they are almost the same for both groups of pilots and are based mainly on general processing difficulties, irrespective of the pilots' L1. If the problems are identical, there is no need to design exercises for each country separately; instead, the existing activities should simply be supplemented with exercises on the common problems.

6.2 Hypotheses

My hypothesis is that Latvian and Norwegian pilots might face difficulties perceiving English sounds which are similar to Latvian and Norwegian sounds, but are not identical, as these sounds might be assigned to the wrong category of native sounds by the listeners. Pilots might also have problems perceiving sounds which are very different from any of their native-language sounds. While the latter are unlikely to be assimilated to L1 sounds, they might be interpreted by the listeners as articulatorily imprecise, as the pilots' ears are not used to them. For example, in a previous study (Sinkova, 2010: 12), I interviewed 10 Latvian pilots and 10 Latvian controllers working in Riga International Airport and they unanimously agreed that articulatory imprecision was one of the main sources of problems in communication with native speakers of English.

It is also hypothesized that Norwegian pilots might be better at differentiating between RP sound pairs than Latvian pilots due to their greater exposure to English in everyday life (for more detailed information on the use of English in Latvia and Norway, see the beginning of chapter 4) and the fact that the Latvian vowel phonemes are less similar to the RP vowel phonemes than the Norwegian ones. It is expected that Norwegian participants will not just be

better than Latvian participants, but that one group of pilots will make different mistakes from the other.

I have identified the following RP sounds as especially problematic for Latvians or Norwegians or both in the contrastive analysis in chapter 4: /ɜ:/, /ʌ/, /ə/, /ɒ/, /ɑ:/, /ɪ/, /ʊ/, /ɪə/, /eə/ and /ʊə/. The comparison of the two sound systems revealed that the Latvian vowel sounds are similar to the Norwegian vowel sounds, but the Norwegian short vowels are more central (apart from the Latvian /æ/). Basically the two groups seem to have problems with the same sounds, but with different types of mistakes. It turned out that the position of /e/, /æ/, and /æ:/ is one of the major differences between Latvian and Norwegian, and that this may affect what kinds of problems each group of pilots is likely to have. For instance, both groups of participants are expected to have difficulties with the perception of the RP /ɜ:/, but the Latvians are believed to confuse it with the Latvian /æ:/, and the Norwegians with the Norwegian /ø:/. Even though both groups of pilots have /æ:/ in their languages, these sounds differ a lot phonetically, and are counterparts to different RP sounds (see the description of the RP sounds tested in the first part of the test together with their Latvian and Norwegian counterparts in the next section, 6.3). Such differences make an important test case for L1 influence and language-specific problems.

As we see from the theory part, listeners do not always tend to mistake the RP sounds with the closest sounds in their own languages. For example, Nilsen (2010: 118) says that Norwegians tend to mistake the RP /ʊ/ for the short /ʉ/-sound (instead of the /u/, which is the closest sound in Norwegian). Vanvik (1975: 16) adds that they also confuse the English /ʌ/ with the Norwegian /ø/.

As stated previously (see chapter 3), listeners might also have problems connected with native speakers' economy of energy, which results in assimilation, elision or any other type of sound reduction, and problems caused by unusual stress.

6.3 Research questions

In the practical part, I tried to find answers to the following research questions:

1) Are there language-specific perception problems?
2) Do perception problems mainly have to do with the specific nuance of the sound or do they affect the ability to distinguish between English phonemes (which could cause misunderstandings)?
3) Does connected speech create additional problems (in ambiguous contexts)?

The test consisted of three parts to answer these research questions. For part 1, I took English words which contained RP sounds that supposedly pose different problems to Latvians and Norwegians. Then I inserted the Latvian and Norwegian *counterpart sounds* in the same English words instead of the real RP sounds. The meaning here of *counterpart sounds* is those Latvian and Norwegian sounds which have the closest sound qualities to the given RP sounds (according to the speaker's tongue position and lip-shape when pronouncing these sounds) and which are located most closely to the RP sounds in the vowel diagram (to compare the Latvian and Norwegian vowel charts with the RP vowel chart, see sections 4.1.1 and 4.2.1). These can also be sounds which Latvian and Norwegian linguists consider to be the closest ones to the original English sound, or those Latvian and Norwegian sounds which are most often mistaken for real RP sounds by Latvian and Norwegian speakers.

The pilots' task was to choose the right Standard British English variant out of several variants, some of which contained the *counterpart sounds* taken from their mother tongues. It was expected that Latvians would choose the Latvian equivalents instead of the right RP variants, while Norwegians would give preference to the Norwegian analogues of the tested RP sounds. Latvian and Norwegian pilots were believed to choose the closest sounds to their native languages, thus revealing the influence of their L1s on the target language. Latvian participants were expected to have more problems in differentiating between diphthongs than Norwegian participants, as in all the Latvian diphthongs both elements are strong, distinct and fully pronounced, in contrast with both Norwegian and RP diphthongs, where the second part of the diphthongs is weaker than the first one, i.e. shorter and less distinct.

Unfortunately, I could not include all the RP sounds in the test due to time considerations, which is why I was forced to make a selection. I decided to focus on the following sounds in the first part of the test: /ɜ:/, /ʌ/, /ə/, /ɪə/, /eə/, /ʊə/, /ɒ/ and /ɑ:/. As for monophthongs, I chose to include the /ɜ:/ and /ə/, as these two RP vowel phonemes were most likely to reveal one major difference between Latvian and Norwegian. This is related to the position of the /e/, /æ/, and /æ:/ in these two languages. Even though both groups of pilots have /e/, /æ/, and /æ:/ in their mother tongues, these sounds are articulated differently and have different counterparts in English. When it comes to the RP /ɜ:/, the Latvians are expected to confuse it with the Latvian /æ:/, which is rather central in Latvian, but the Norwegians with the Norwegian /ø:/. Norwegian participants are expected to choose the tested RP schwa, since they have a schwa-like vowel in their native language, while their Latvian colleagues are expected to choose the Latvian /e/ or /æ/ instead.

The Norwegian linguists Nilsen (2010: 118) and Vanvik (1975: 16) mention that the two English sounds /ʌ/ and /ʊ/ are most likely to be pronounced not as the closest sounds in Norwegian, but as /ø/ and /ʉ/. I wanted to include these sounds in the test, since they should also give different results for Norwegians and Latvians. Due to time limitations, I decided to test only the /ʌ/, as it seems even more different from the Norwegian /ø/ than the /ʊ/ from the Norwegian /ʉ/ according to the two parameters of tongue position.

Next, I wanted to have some control sounds, where the groups are expected to perform in the same way. That is why I included the /ɒ/ and /ɑ:/. Both groups of participants are expected to choose the /ɔ/ and /a:/ instead of the right RP phonemes. Even though Latvians and Norwegians are believed to act in the same way, the /ɔ/ and /a:/ are articulated a little bit differently in Latvian and Norwegian. The Norwegian sounds are less open than the RP phonemes, and the Latvian counterparts are even closer than the Norwegian sounds. This difference indicates that the Latvian sound system is less similar to the RP sound system than is the Norwegian one. Thus, Latvians might make more mistakes with the control sounds than their Norwegian colleagues.

Concerning my choice of diphthongs, Latvian linguists claim that Latvians have particular problems with the RP /ɪə/ and /eə/ (Kaurāte *et al*., 1985: 41–42). Linguists describing Norwegian learners single out the same diphthongs as being hard for Norwegians, together with the RP /ʊə/ (Hughes *et al*., 2005: 50; Vanvik, 1975: 26). The sounds that Latvians and Norwegians are supposed to choose instead of these RP phonemes are different, and would provide further evidence for L1 transfer. All three diphthongs mentioned above were included in the first part of the test.

Below I list the RP sounds which were tested in the first part of the test together with their Latvian and Norwegian counterparts:

1) The RP sound /ɜ:/ – Latvians are expected to confuse it with the Latvian /æ:/, but Norwegians with the Norwegian /ø:/.
2) The RP sound /ʌ/ – Latvians are expected to choose the Latvian /a/, but Norwegians the Norwegian /ø/ instead.
3) The RP sound /ə/ – Norwegian pilots are expected to choose the right variant. As mentioned in section 4.2.1, some linguists (e.g. Popperwell, 2010: 12–13; Vanvik, 1983: 26) consider that there is schwa in Norwegian. Latvian pilots are expected to assimilate the /ə/ either to the Latvian /æ/ or to the Latvian /e/.

4) The RP diphthong /**ɪə**/ – Latvian participants are believed to decide on the /iə/, while Norwegians on the /eə/ instead.
5) The RP diphthong /**eə**/ – Latvians are expected to confuse it with the /æə/, but Norwegians either with the /æːə/ or with the /eːə/.
6) The RP diphthong /**ʊə**/ – Latvian pilots might confuse this sound with the Latvian diphthong /uo/, but Norwegian pilots with the Norwegian sound /ʉ/.
7) The RP sound /**ɒ**/ – both Latvian and Norwegian participants are expected to choose the /ɔ/.
8) The RP sound /**ɑː**/ – both Latvians and Norwegians might choose the /aː/ instead.

A more detailed description of these RP sounds and a comparison with their Latvian and Norwegian counterparts can be found in chapter 4.

The first part of the test was closely related to the hypotheses of this study and attempted to check whether the two groups of pilots shared the same problems, which are universal, or whether there are language-specific perception problems which are influenced by the participants' L1s. However, it is more dangerous if the pilots not only assimilate the heard information to their mother tongues, but also mix the existing English phonemes, which can lead to serious consequences. In the second and third parts of the test, I tested the pilots' ability to distinguish between English phonemes. In part 2, I tested the participants' ability to distinguish between English phonemes in connected speech, as, according to one of my hypotheses, listeners might have problems connected with the economy of energy of native speakers, characteristic mainly of connected speech. The part with connected speech was placed second to create more variety in the test. In part 3, I tested the pilots' ability to distinguish between phonemes in isolated words. Then I compared the ability to hear phonemes in isolated words with the ability to distinguish them in connected speech.

Norwegian pilots were supposed to have an advantage over Latvian pilots regarding stress patterns, which was expected to show up mainly in the second part of the test on connected speech. This is due to the fact that English and Norwegian are *stress-timed* languages, i.e. stresses occur at roughly equal timing intervals, while Latvian employs syllable rhythm, i.e. syllables come at equal intervals, taking the same relative length of time (for a more detailed description, see section 3.7).

In parts 2 and 3, six pairs of RP monophthongs and three pairs of RP diphthongs were tested. This time I also had to make a selection, as I could not test all the sounds due to time

limitations. It follows from the comparison of the RP sound /ɪ/ with the Latvian and Norwegian counterparts, that the RP phoneme is more open and back than the Norwegian sound, and even more open and back than its Latvian counterpart. Norwegians tend to mix this vowel phoneme either with the RP /i:/ (Nilsen, 2010: 105) or with the /e/ (Vanvik, 1975: 15). Here, I decided to compare the perception of the /ɪ/ with the perception of the /e/, as the articulation of the /e/ differs more in Latvian and Norwegian than the articulation of the /i:/, and it would be interesting to see whether this difference would influence the pilots' decisions.

Next, I tested whether the participants would mix the /ə/ with the /ɪ/, or the other way round. I chose to look at this sound pair, as the schwa seems to be a problematic sound for both Latvians and Norwegians. While the Latvian sound system does not contain this sound at all, the Norwegian unstressed /e/ is reminiscent of the schwa (Popperwell, 2010: 12–13; Vanvik, 1983: 26). However, it is still not as central as the RP variant. The RP /ɪ/ is closer to schwa than the Latvian and Norwegian /i/ is; that is why the pilots might confuse these two phonemes.

I included the vowel phonemes /e/ and /æ/, as the articulation of these sounds differs greately in Latvian and Norwegian. The Latvian /e/ is more close and front than the RP /e/, while the Norwegian /e/ is more open and back than the English sound. The Latvian /æ/ is closer and more central than its Norwegian and RP counterparts. It would be interesting to see how these differences in articulation of the counterpart sounds in the pilots' L1s would influence their perception of the RP sounds.

Linguists describing both Latvian and Norwegian learners (Hughes *et al*., 2005: 50; Kaurāte *et al*., 1985: 41–42; Vanvik, 1975: 22) note that the diphthongs /ɪə/ and /eə/ are the most difficult diphthongs (also the diphthong /ʊə/ for Norwegians). Although I tested the perception of these diphthongs in the first part of the test, I decided to include them also in the second and third parts to see whether the pilots mix these two diphthongs. Vanvik (1975: 26) says that the /ɪə/ can be easily mistaken for the /eə/ by Norwegian listeners.

In the second and third parts, I also tested the RP diphthongs /əʊ/ and /aʊ/, which are expected to create difficulties for both groups of pilots, as the counterpart diphthongs are articulated differently in Latvian and Norwegian. I also wanted to test whether the Latvian participants would have more problems with the perception of these diphthongs than the Norwegians. The fact that all the diphthongs in Latvian are dictinct and fully pronounced creates an additional challenge for Latvian pilots in terms of their perception of diphthongs with a weak second part.

I also added some control sound pairs with which to compare the problematic ones: /ʌ/ vs. /æ/, /ʌ/ vs. /ɒ/, /u:/ vs. /ɔ:/ and /eɪ/ vs. /aɪ/. The Norwegian and Latvian vowel systems should not create particular problems in distinguishing between these sounds. If they are indeed easier for them than the rest, that would support the conclusion that the other problems are caused by transfer.

The six pairs of RP monophthongs included in the second and third parts of the test are as follows:

1) The /**ɪ**/ vs. /**e**/ – this pair of monophthongs is expected to be difficult for both groups of pilots. The /ɪ/ is more likely to be heard as /e/ than the other way around, as the RP /ɪ/ is more open than the Latvian and Norwegian /i/ and therefore closer to their /e/.
2) The /**ʌ**/ vs. /**æ**/ &
3) The /**ʌ**/ vs. /**ɒ**/ – the RP /ʌ/ is similar to the Latvian and Norwegian /a/. While Latvians are expected to confuse it with /a/, the Norwegians are predicted to choose the Norwegian /ø/ instead. I hypothesize that the problem would not only pertain to production, but also to perception. In the first part, I tested whether the pilots would mix the /ʌ/ with the /a/ and /ø/. In the second and third parts, I included the control sounds /æ/ and /ɒ/ to see whether the pilots would confuse the RP /ʌ/ more with the expected sounds /a/ and /ø/ than with the sounds /æ/ and /ɒ/. I would not expect them to confuse the /ʌ/ with the /æ/ or /ɒ/. However, if they still do, it is more likely that they mistake the /ʌ/ for the /æ/ because it is unrounded like the /ʌ/. The Norwegians are expected to have fewer problems distinguishing the /æ/ from the /ʌ/ than vice versa, as the Norwegian /æ/ is very close to the RP /æ/. The Norwegian short /ɔ/ is closer to the RP /ɒ/ than the Latvian /ɔ/. Therefore, Latvians might perceive the /ɒ/ as the /ʌ/ more readily than Norwegians.
4) The /**ə**/ vs. /**ɪ**/ – the RP /ɪ/ is more central and open than its Latvian and Norwegian counterpart, thus it might create some difficulties for Latvian and Norwegian ears. Still Latvian pilots are more likely to have problems with the perception of the /ə/, which is not present in Latvian at all. Norwegians are also expected to have problems with the /ə/, as the Norwegian schwa is less central than the RP schwa (for a more detailed description of the Norwegian schwa, see section 4.2.1), though to a lesser extent than Latvians.
5) The /**e**/ vs. /**æ**/ – even though both of these sounds exist in Latvian and Norwegian, they represent one of the major differences between these two languages (see figure 12 in chapter 4). Norwegian pilots are not expected to have problems with the perception of the

sound /æ/, as the articulations of the Norwegian and RP /æ/ are very similar. Latvians, on the contrary, might find it difficult, as the Latvian /æ/ is much closer and less front than the Norwegian and RP sound. As for the /e/, both groups of participants might face difficulties with this vowel phoneme. The Norwegian /e/ is more open and back than the RP /e/, and the Latvian /e/ is closer and more front than the RP /e/ (see figure 12 in chapter 4).

6) The /**uː**/ vs. /**ɔː**/ – this distinction should be easy for both Latvians and Norwegians because they have a similar distinction in their languages. However, the English /uː/ is more central than the Norwegian and Latvian /uː/. That is probably why it would be more difficult for them to distinguish the /uː/ from the /ɔː/ than vise versa.

The three tested pairs of RP diphthongs were:

1) The /**ɪə**/ vs. /**eə**/ – both Latvians and Norwegians might have difficulties with these diphthongs. The Norwegians are expected to have more difficulties with the perception of the diphthong /ɪə/, as, according to Vanvik (1975: 26), it is often perceived as /eə/ by Norwegian ears. Vanvik says that Norwegians tend to use the Norwegian /eː/ or /æː/ as a starting point for the English /eə/, but it seems that they are unlikely to mix the two diphthongs due to this mistake. The situation is different for Latvians. The Latvian /e/ and /i/ are more front and closer than the Norwegian and RP phonemes. That is why both the tested diphthongs might create considerable difficulties for Latvian listeners. Both diphthongs might be easier for Norwegians also because they have diphthongs with a weak second part.
2) The /**əʊ**/ vs. /**aʊ**/ – Latvians and Norwegians are expected to have fewer problems with the /aʊ/ than with the /əʊ/, as the /a/ is found in both of these languages. But especially Latvians may have problems, as Latvian has an /au/, whereas Norwegian does not have a similar sound to the RP /aʊ/. As for the schwa, some linguists (Popperwell, 2010: 12–13; Vanvik, 1983: 26) include it in the Norwegian sound system; however, the unstressed Norwegian /e/ is still not as central as the RP /ə/. The schwa does not exist in Latvian at all. That is why the /əʊ/ is supposed to create even more problems for Latvians than for Norwegians. The second element of this diphthong, /ʊ/, is articulated differently in Latvian and Norwegian. Therefore, both of these diphthongs seem to be problematic for Latvian and Norwegian pilots. The fact that Latvian diphthongs do not have a weaker second part might cause more difficulty for Latvians, especially in perceiving this part.

3) The /**eɪ**/ vs. /**aɪ**/ – this sound pair does not seem to create difficulties for either group of pilots, as very similar sounds exist in their native languages.

In all three parts of the test I looked at how the participants perceived the same RP sound in several different words. It was important to check how they perceive sounds in more than one word in order to see whether the pilots had difficulties with the particular phoneme in every tested word which contained it, or whether the perception of the same sound was not identical in different words. In the latter case it might mean that the problem is not in the perception of the tested RP phoneme, but something else to do with the tested word, and we would not be able to conclude that there is any influence of the participants' L1s on the perception of a certain vowel phoneme.

In the next chapters I will describe the participants, the administration of the test and the results of the study. I will analyse the findings, present the answers to the research questions and discuss whether the findings confirm my hypotheses or not.

7 Method

Aiming to get answers to the research questions formulated in the previous section (see section 6.3), I designed a questionnaire and a test. In this chapter I will describe the design of the questionnaire and the test, and provide general information about the participants who took part in the study. Then I will touch upon the administration of the questionnaire and the test by giving details on where the practical part of the study took place, how it was conducted, how many people participated in each sitting of the test, etc.

7.1 Design of the questionnaire and test

Design of the questionnaire

The questionnaire consisted of 13 questions (see appendix 5). The questions were divided into four logical parts.

The first part of the questionnaire was constructed to elicit some personal information about the participants which would help the reader to get an overall notion of them and the factors which might have influenced their behaviour during the test. The pilots were asked to give their age, gender and years of professional experience. It might be the case that older Latvian pilots would be less proficient in English, as they might have received their education in the Soviet Union, where English was not taught properly, if at all. On the other hand, many years of professional experience might indicate professionalism and a good orientation in their work sector, including competence in communication. Even though it would have been interesting to study how the pilots' age, gender and professional experience influence the way they perceive RP sounds, this is unfortunately beyond the scope of the present study. These factors were not controlled for in the sense of selecting an equal number of people for different age groups, etc., and the data is thus only used as extra information when comparing the two nationality groups overall.

In the second part, the pilots were asked how many years they had studied English, whether they had lived in English-speaking countries, whether they had had English as a language of instruction while studying and how often they used English in their everyday life. The pilots were further asked what proficiency level they had in English according to the ICAO Language Proficiency Rating Scale: Operational Level 4, Extended Level 5 or Expert Level 6 (information about ICAO language proficiency requirements and ICAO Language Proficiency

Rating Scale can be found in section 5.1). This information would help reveal the pilots' level of English proficiency and compare the levels of the Latvian and Norwegian participants. It was hypothesized that Latvian pilots would have received less English instruction than Norwegian pilots and that they would be less experienced with the target language, as English is less frequently used in Latvia than in Norway. In the last question of this part of the questionnaire, the pilots had to evaluate their listening skills themselves. They had four options to choose between: unsatisfactory, satisfactory, medium and good. These data can also be used to compare the actual test results with the pilots' experience with the target language and their self-assessment.

The third part of the questionnaire asked the pilots what studying materials they had used to achieve ICAO Level 4, as I have not managed to find an answer to this question in any other sources. This information can be used to study the existing materials before starting to supplement the curriculum with new activities.

In this part, the pilots were also asked to evaluate two aspects of the teaching programme used in preparation for the ICAO examination, namely the listening activities and the English phonetics section. This question was asked to find out whether the participants were satisfied with the English instruction they had received or not. After that, the participants were invited to evaluate whether the ICAO examination on English language proficiency conducted in Latvia/Norway truly reflects the pilots' proficiency level in listening to standard phraseology, listening to plain language used in emergency situations, listening to native speakers and listening to non-native speakers of English. I introduced this question because I wanted to find out whether the pilots considered the ICAO examination to be fair in their country or whether they were not satisfied with the existing method of language assessment. I want to remind the reader that there is no single international English language examination, and each country designs its own examination in compliance with the ICAO Standard (see section 5.1).

The fourth part of the questionnaire asked the pilots whether they would like to introduce any changes to the teaching programme used in preparation for the ICAO examination which they had had and invited them to write comments and suggestions. I designed this question to take the pilots' wishes and suggestions into account in case of future supplementation to their language curriculum.

Design of the test

The test had three parts (see the Latvian and Norwegian versions of the test, and the test with the phonetic transcriptions in appendix 6; the recordings of each part of the test can be found on the disc in appendix 11).

The first part of the test contained 24 items. In each item the pilots were asked to listen to the same word pronounced in different variations and to choose the right Standard British English/RP variant. In most cases the participants had to choose between three variants. One of these variants contained an RP sound (the right answer with the right pronunciation of the English word), in the other two variants the particular vowel sound (which was hypothesized to be difficult for Latvian and/or Norwegian pilots) was substituted with its Latvian and Norwegian counterparts (to see the principles according to which Latvian and Norwegian counterpart sounds were chosen, see section 6.3). In some cases, when Latvian and Norwegian counterpart sounds were the same, the pilots were to choose between two variants. In three of the items, the participants had to listen to four different variants, because there were two possible counterpart sounds in Norwegian. At the beginning of this part, the participants listened and responded to an example item to make sure that they had understood the task. The example was not assessed. All in all, eight RP sounds were tested in the first part. Each sound occurred in three different English words in different orders to increase the reliability of the results (see a list of these sounds and their Latvian and Norwegian counterparts in section 6.3).

There were 27 items in the second part of the test. The participants were asked to choose the word they heard from minimal pairs that differed only in the vowel sound in question, e.g. *pen* vs. *pin* or *cup* vs. *cap*. Every word pair occurred in sentences. This creates additional challenges with word perception in connected speech (see information about problems listeners have with vowels in connected speech in chapter 3 and in sections 4.1.2 and 4.2.2). As in the first part, there was first an example item. Altogether the participants were tested on 6 monophthongs and 3 diphthongs. Each pair of sounds was tested in three different word pairs in different orders to increase the reliability of the findings (see these monophthong and diphthong pairs and hypotheses regarding their difficulty for Latvian and Norwegian participants in section 6.3).

In the third part of the test, I included the same monophthong and diphthong pairs as in the second part of the test, but the words were presented in isolation, out of context. (The results from the second and third parts were to be compared in order to find out whether connected

speech presented additional challenges for phoneme perception.) The participants were asked to listen to the recording for each item and to indicate which of the two words on their sheet they heard, e.g. *bit* vs. *bat* or *luck* vs. *lack*. There were 18 items in this part. Each sound pair was repeated twice in different word pairs in different orders. This part also contained an example in the beginning which was not assessed.

7.2 Description of participants

Before moving to the results of the test, I will present the information about the Latvian and Norwegian participants obtained from the questionnaires. I will start with their personal background and experience with English, as this might have had an effect on their performance in the test. I will proceed with the study materials they have used, their evaluation of the English teaching programmes and of the ICAO examination on English language proficiency conducted in their home countries, as well as a description of changes they would like to introduce to the teaching programme used in preparation for the ICAO examination.

General information about the Latvian and Norwegian pilots

Altogether 30 Latvian pilots and 48 Norwegian pilots took part in the present study. The youngest Latvian pilot was a 22-year-old student pilot. Eight Norwegian student pilots were even younger: six of them 21, one 20 and one 19 years of age. The average age of the Latvian pilots was 35 years compared to 28 years for the Norwegians. The oldest Latvian test taker was 68 years old, while the oldest Norwegian participant was 54 years old. The two figures below show the age distribution in more detail:

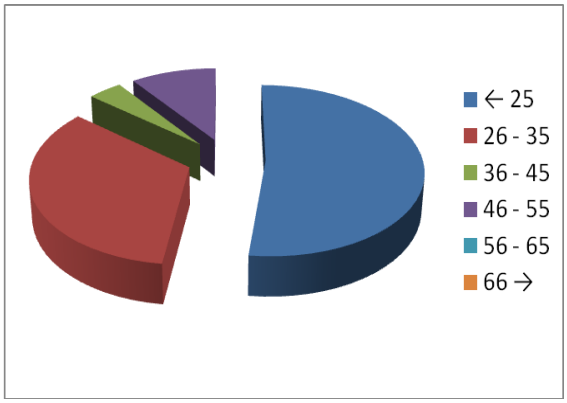


***Figure 17*, Age of Norwegian pilots**

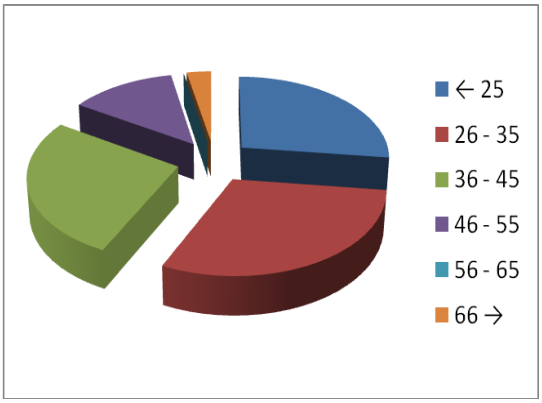


***Figure 18*, Age of Latvian pilots**

On average, the Latvian participants had 11 years of professional experience as pilots, while their Norwegian colleagues had only 5 years. This difference can be easily explained by looking at the

participants' age. The Norwegian test takers are younger than the Latvian pilots. It seems that both the Latvian and the Norwegian pilots started their careers at approximately the same time – when they were about 23 (for the Norwegian pilots) or 24 (for the Latvian pilots) years old.

All the Latvian pilots who took part in the present study were male. Among the Norwegian pilots, there were only two female participants.

Further, both groups of pilots were asked to provide information about their experience with English. They were asked how many years they had been studying English, including any English language instruction at university, high school, school, courses, kindergarten, etc. The findings show that the average number of years of English instruction for the Norwegian test takers is 11, while for the Latvian test takers it is 9 years.

The next question asked whether the pilots had lived in English-speaking countries. According to their answers, more than half of the Norwegian participants (60%) and a little less than one third of the Latvian participants (27%) had lived in English-speaking countries. However, living in English-speaking countries did not necessarily imply having English as a language of instruction for the Latvian participants. To the question *Have you had English as a language of instruction?* 94% of the Norwegian respondents answered *yes*, while only 47% of the Latvian respondents gave a positive answer. Some of those who gave a negative answer had lived in English-speaking countries. The pilots' answers reflect the way English is taught in Latvia and Norway. In Norway, the instruction is usually in English, even in school. In Latvia, the English teaching at school or high school is not necessarily conducted in English.

Then the Latvian and Norwegian pilots were asked how often they used English in their everyday life. I explained to the pilots that I did not mean the Standard Phraseology which they are normally supposed to use every day when they are on duty. I meant general English used to communicate information to their colleagues. The majority of the Norwegian participants used English every day (54%), while the majority of the Latvian participants used English only several times a month (47%). Among the rest of the Norwegians, 29% used English several times a week, and 17 % several times a month. As for the Latvian pilots, only 10% used English every day, 23% several times a week and 20% less often than several times a month.

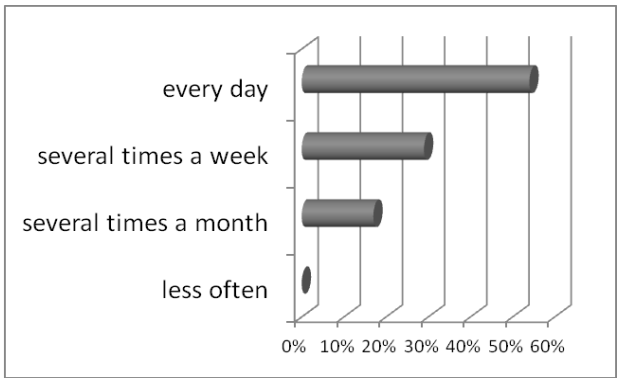


Figure 19, **How often the Norwegian pilots use English in their everyday life**

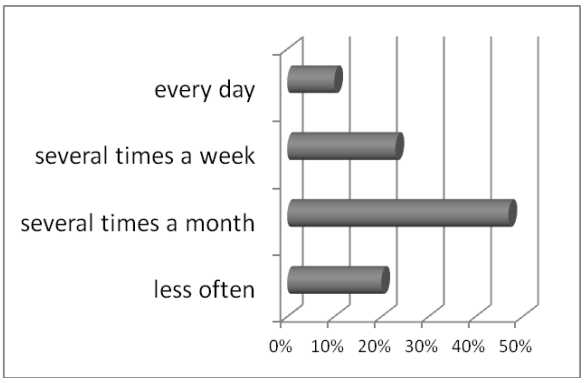


Figure 20, **How often the Latvian pilots use English in their everyday life**

As mentioned in section 5.1, the pilots' speaking and listening skills are assessed according to the ICAO Language Proficiency Rating Scale (see appendix 3), which consists of six levels of language proficiency. Operational Level 4 is the minimum required proficiency level for radiotelephony communication. Pilots who have attained ICAO Operational Level 4 have to repeat a language examination three years later; those who have ICAO Extended Level 5 have to retake it five years later; pilots who are assigned ICAO Expert Level 6 do not have to take the exam any more (ICAO, Manual on the Implementation of ICAO Language Proficiency Requirements, Doc 9835 AN/453, 2004: A-9). The pilots' answers showed that all the three possible levels of English language proficiency were almost equally divided between the Norwegian pilots: 27% had attained level 4, 36% had got level 5 and 33% had been assessed as proficient at level 6. There were a few (4%) who had not taken the examination yet. In contrast to the Norwegian participants, the major part of the Latvian test takers (53%) had the minimum required proficiency level 4, while the rest had been assigned level 5. None of the Latvian pilots had got level 6 in the English language examination. As many as 37% were student pilots who had not taken the test yet.

The results of the questionnaire indicate that the Norwegian participants were more experienced with the target language than their Latvian colleagues, as hypothesized. The Latvian pilots lacked everyday practice with the language and more than half of the Latvian participants had never had English as a language of instruction while studying. Moreover, none of the Latvian pilots, as opposed to the Norwegian participants, had been assessed as proficient at Expert Level 6.

Study materials

Unfortunately, many Latvian (57%) and Norwegian (13%) respondents decided to skip this question. The reason could be that the pilots took the examination some time ago and did not remember what study materials they had used. Some of the Norwegian participants wrote that they were still pilot students and had not taken the ICAO examination yet.

From the answers, it appears that the Latvian pilots had more preparation for this examination than the Norwegian pilots. This seems logical, as the Latvian pilots have less opportunity to practice the language in a natural environment. The Latvian respondents mentioned the names of some language schools in Latvia, Russia and the U.S.A. where they had taken preparation courses for the examination. Six (20%) of the Latvian participants mentioned Mayflower College training (see the description of the Mayflower College Internet-based English language assessment and training programme for pilots *Climb Level 4* in section 5.3). Three Latvian pilots, or 10% of the respondents, said that they prepared for the examination themselves.

The number of Norwegian respondents who said that they did not have any preparation for the language examination at all or prepared themselves was considerably higher: 54%. There were three pilots who wrote in comments that it is not always necessary to take a special language examination in Norway. In many cases, it is the pilot's flight instructor who gives the pilot a certain level of English language proficiency after talking to the pilot during his/her training. One Norwegian pilot mentioned Oxford training.

Evaluation of whether the ICAO examination conducted in Latvia/Norway truly reflects pilots' proficiency levels

Both groups of pilots were asked whether the ICAO examination in their home country truly reflected their level of English proficiency. They had to indicate their agreement on a scale from A to D. There was no single pattern regarding how the pilots answered this question. The participants had different opinions.

However, both groups of pilots agreed more than disagreed that the ICAO examination in their home country truly reflected their proficiency level in listening to standard phraseology (the Norwegian participants: A–21%, B–49%, C–27%, D–3%; the Latvian participants: A–31%, B–46%, C–15%, D–8%). The answers were fairly similar when it comes to listening to plain language used in emergency situations (the Norwegian participants: A–21%, B–33%, C–43%,

D–3%; the Latvian participants: A–8%, B–46%, C–46%, D–0%). As regards listening to native and non-native speakers of English, the Latvian respondents believed to a lesser extent than the Norwegian participants that the ICAO examination held in their home country truly reflected pilots' knowledge and abilities. There were just a few Latvian pilots who completely agreed to this: the majority of participants slightly agreed or disagreed (listening to native speakers: A–7%, B–31%, C–31%, D–31%; listening to non-native speakers: A–15%, B–31%, C–23%, D–31%). The majority of the Norwegian test takers avoided expressing strong opinions. In both cases most of them slightly agreed or slightly disagreed (listening to native speakers: A–16%, B–36%, C–36%, D–12%; listening to non-native speakers: A–15%, B–40%, C–30%, D–15%). The overall results of the pilots' evaluation of whether the ICAO examination conducted in their home country truly reflected their proficiency levels are shown in the figures below:

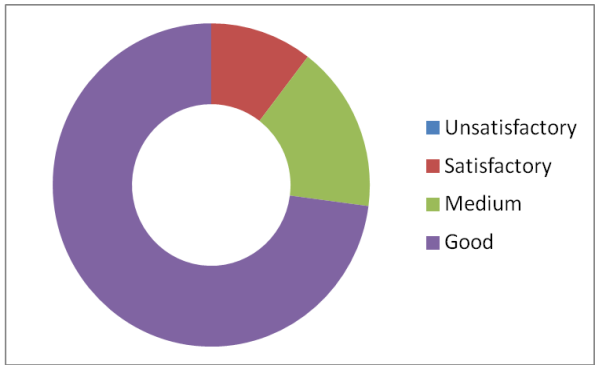


Figure 21, **The Norwegian pilots: evaluation of their listening skills**

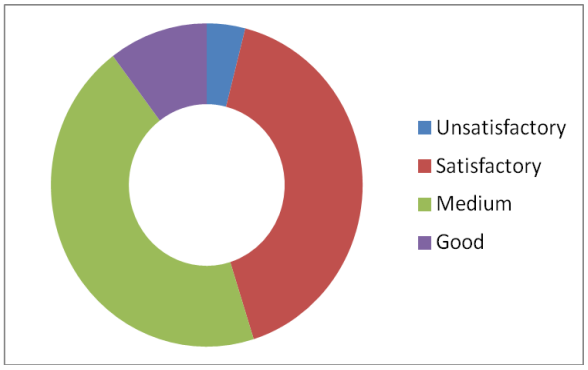


Figure 22, **The Latvian pilots: evaluation of their listening skills**

Initially, there was one more question in the evaluation section: *Please evaluate several aspects of the English teaching programme for preparation for the ICAO examination you have had*. It turned out that the question was not so relevant, as the pilots did not have any common preparation programme. Many participants had prepared for the ICAO examination on their own. Some of them did not have any preparation at all. That is the reason why this question is not discussed further.

Satisfaction with the existing situation concerning the preparation for the ICAO examination (or the lack of any single/compulsory preparation programme)

As many as 33% of the Norwegian pilots and 66% of the Latvian pilots did not respond to this question; some of them had not taken the examination yet. Altogether 54% of the Norwegian and 17% of the Latvian respondents were satisfied with the existing system and did not want to

introduce any changes. Some of the Norwegian participants (13%) wanted to introduce changes and provided arguments to support their opinion, such as: not enough weight is put on teaching plain language in contrast with the standard phraseology; pilots do not have easy access to study materials; the teachers and examiners are not competent enough, as they are usually experienced staff members, but not language experts; there are no formal training requirements, which makes it problematic to communicate with colleagues from Eastern Europe as they do not have enough language training and often do not understand what Norwegian pilots are saying; there is not enough preparation for the ICAO examination, etc. A number of Latvian pilots (17%) also agreed that the existing system should be changed. One of the Latvian pilots suggested that development of speaking skills should be compulsory in the preparation for the ICAO examination.

In the final comments and suggestions section, a number of the Norwegian participants wrote that they considered the present study important as it may cause changes in teaching English language to pilots not only in the "Western World", but also in the East, and prove that problems with language teaching do exist. The pilots said that they were glad to take part in this study and were prepared for future cooperation.

7.3 Administration of the questionnaire and test

In this section I will name the people who helped with the organization of the test, describe the time, location and physical environment in which the test was conducted, and say a few words about the responsibilities of the administrator during the test.

People who helped with the organization; time & location: Latvia

The 30 Latvian pilots were tested on 28 February 2012 during the Flight Instructor Refresher Training in the Latvian Civil Aviation Agency premises in Riga International Airport (Airport "Rīga", LV-1053, Latvia). The seminar was organized by the Head of the Air Traffic Management Section of the Latvian Civil Aviation Agency, Ērika Neimane, who invited me to conduct the practical part of my study.

People who helped with the organization; time & location: Norway

The 48 Norwegian pilots were tested on 24 May 2012 during an informal professional meeting of Norwegian pilots in the Norwegian Airline Pilots' Association in Lysaker (Oksenøystien 2, NO-

1366, Lysaker, Norway). I was invited to conduct the test during this meeting by Knut Backer, the Vice President of the Norwegian Airline Pilots' Association.

The physical environment & participants: the Latvian pilots

The Latvian pilots took the test in a comfortable conference room meant for 10 students and a teacher. In order to ensure sufficient seating, the pilots were divided into three groups of 10 people, and the test was given in three sessions. All three sessions were conducted in identical circumstances. There was sufficient light in the room, the temperature was around 20 degrees, and there were no disturbing noises.

I was present myself during all the three sessions, and I had an assistant, Lelde Zena, who helped me with organizational matters, such as making enough copies of the questionnaire and the test, having enough pens, adjusting technical equipment, providing the participants with drinks, etc.

A computer and loudspeakers were used to play the recordings during the test. The Latvian Civil Aviation Agency asked a technician to help me in case there were problems with the sound quality or volume; however, the equipment was checked several times beforehand, and, fortunately, there were no unpredictable failures in the system.

The first group of the Latvian pilots was tested at the end of the first day of their seminar at 15.00. The second and third groups were tested half an hour after the previous group. The test takers did not seem to be fatigued, as they had a one-hour break for lunch, as well as systematic 15-minute breaks. The test takers did not feel anxious, as the test was voluntary and anonymous, without any future consequences for their career. For the same reason, the level of motivation of the participants might not have been so high.

The physical environment & participants: the Norwegian pilots

The Norwegian pilots were tested in a small conference room with 8 seats altogether. The test was conducted in multiple sessions with 4 to 6 participants at a time. All the sessions were held under identical circumstances. Although the room was small, it was light, comfortable, and with good sound isolation to prevent any distractions.

I took part in all the sessions with the Norwegian pilots together with my assistant, Jeanne Le Lamer, who helped me with practical matters. The sessions with the Norwegian pilots turned out to be more informal than the sessions with the Latvian pilots. The Norwegian pilots took food and drinks in the conference room themselves, and after the sessions they were eager

to discuss the test, their personal experience with English and the ICAO examination conducted in Norway.

The recordings were played with the help of a computer. There was no additional technical equipment in the room, but it was enough to ensure a proper volume and good sound quality, as the room was quite small.

The professional meeting of the Norwegian pilots started at 17.00, and after 15 minutes the first session was held. All the sessions took place one by one with small 5–10-minute breaks between the sessions. The pilots were not tired and showed a high willingness to participate in the study.

The test takers did not feel anxious; however, at the same time I suppose they might also have less reason to be motivated as the test was not compulsory, it was anonymous, and the results of the test were used only for research purposes.

Responsibilities of the administrator

Scheduling the test for the Latvian pilots, I insisted that the test time was not before lunch time when the pilots were tired, as it had been initially planned by the seminar organizers. The Norwegian pilots also did not take the test during lunch-time or any other break. The test did not take longer than half an hour for any groups of participants so that their attention was not distracted. The chances of cheating were not minimized through seating arrangements, but cheating was almost excluded as all the test takers were under constant supervision.

Administration & analysis of the test

The test lasted around 20 minutes. There were no breaks between the three parts. All the participants were given proper instructions before the test started and at the beginning of each part of the test. The instructions contained information about how to perform the tasks and the purpose of the tasks. I said a few words about why it was important to conduct the test and what the results of the test can be used for.

The pilots had several seconds between each recording to choose between the given variants. All the recordings were played only one time and were not repeated. The pilots were asked to concentrate their attention at once.

The answers were analysed manually with the help of the Windows Excel computer programme to save the results, to add right and wrong answers and to calculate percentages. I designed tables for every item of the test, and placed all the possible answer variants in vertical

columns and the participants (e.g. Latvian pilot 1, Latvian pilot 2, etc.) in horizontal columns. There were separate tables for the same items for Latvian and Norwegian pilots (see these tables in appendices 8, 9 and 10). The test takers were given 1 point for the right answer and no points for wrong answers in each part of the test. These scores were then summed, the percentages for each answer were calculated and the answers of the two groups of pilots were compared. When pilots had made corrections to their original answer, I scored them according to the corrected version, and penalties for corrections were not given. There was a Latvian pilot who had many missing responses in the second part. His answers were not counted in the analysis of this part.

Taking into account that assessment is not an objective thing, I used the following criteria to assess the participants' mastery of a particular sound: if the participants had 80% right answers or more, I considered that they did not have problems with the tested sound; if they had 50% right answers or less, I regarded the sound in question as problematic.

8 Presentation and discussion of the results

In this chapter I will present the results of the test. I will give an overview of the answers of the Latvian and Norwegian pilots, analyse each group of sounds or sound pairs separately and illustrate the participants' answers with figures. Then I will discuss the findings.

I will start with the statistical analysis of the overall results of the two groups of pilots. The statistical significance of the difference in results was checked using an independent t-test. A t-test was chosen as a method for analysing the data, as the present study has only two groups of participants, the research data are continuous and the test scores are the only variables. The purpose of the statistical analysis is to prove that the average results of the two tested groups are different and depend on the participants' belonging to the group. This kind of test is used to define the *probability* that two samples (i. e. the two groups of pilots) represent two different populations (Larson-Hall, 2012: 249). The total number of correct answers for both groups of pilots were used as data for the test. It is essential for such a test that the data is continuous, i.e. that every individual result may vary from 0 to the maximum score (69 in this case).

In order to perform a planned t-test, it is necessary to formulate a null hypothesis, the hypothesis which proposes that there is no statistical significance between variables (*ibid*.: 246). The null hypothesis can be simply confirmed or rejected by the results of statistical analysis, giving a clear answer to the research question. The null hypothesis in this case is as follows: *the difference in the number of correct answers between the two groups of pilots is not statistically significant.*

Statistical analysis of the test results was performed with the help of GraphPad web tools (Motulsky, 2012) and the Excel programme, by entering the participants' scores. According to the statistical analysis, the p-value = less than 0.0001, which means that the difference between the groups is *extremely statistically significant* (if the result is less than 0.05, the null hypothesis is to be rejected; Larson-Hall, 2012: 247). In other words, the results of the two groups that participated in this study are *independent*. It means that their behaviour is different, and there is evidence that they belong to two different groups.

I calculated the number of correct answers for each group of participants for the whole test. The results of the analysis allow us to conclude that the Norwegian pilots demonstrated better results and therefore recognize RP sounds better. The distribution of correct answers of the

two groups of pilots, as well as the average result of each group, is indicated in figures 23 and 24. The results are sorted from small to large.

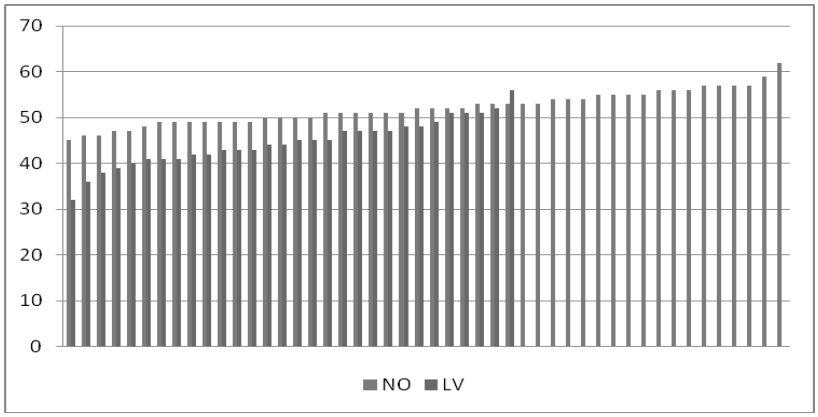


Figure 23, **Distribution of correct answers for Latvian and Norwegian pilots**

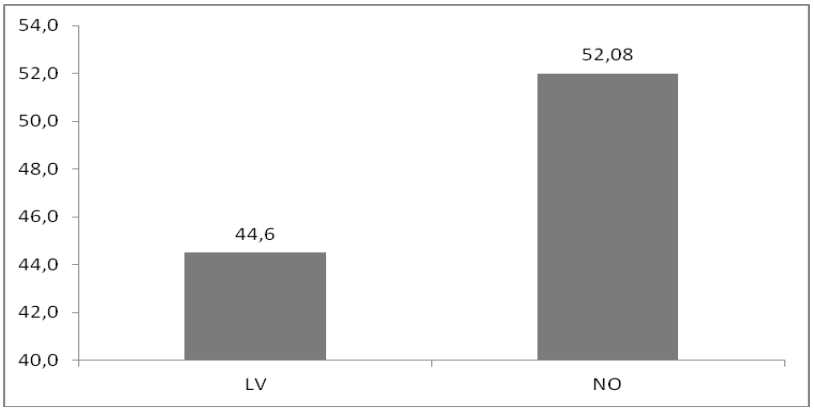


Figure 24, **Average results for Latvian and Norwegian pilots**

The Norwegians have a mean (M) of 52.08, and the Latvians one of 44.6. In addition, the Norwegians have more homogeneous results with a variance of 3.64 standard deviations. Standard deviations for the Latvians constitute 5.13. (For more detailed information on these statistical results, see appendix 7.) High homogeneity and comparatively high average test results, as in the case of the Norwegians, is a sign that not only several individuals have a good knowledge of English, but the whole test group. As for the Latvians, there is a larger gap between those who have a good score and those who have problems with the perception of the RP sounds.

The statistics show that the two groups are statistically different indeed. Now I will proceed with the results of the test and discuss in what aspects they are different.

8.1 Part 1

In this part of the test, the pilots were listening to the same word pronounced several times with different vowel sounds. One of these sounds was an RP sound and the right variant, the other sounds were the Latvian and Norwegian counterparts of the same RP sound. Thus the participants could decide on the right variant, the expected variant (the counterpart sound in their mother tongue) or on unexpected variant. Sometimes Latvian and Norwegian counterpart sounds were the same. In these cases, the pilots were asked to choose between the two sounds – the right one and the expected one. Two times there were two counterpart sounds for the same RP sound, once for Latvian and once for Norwegian. In the first case, there were still three options to choose between, as the Norwegian pilots were expected to decide on the right RP variant, but the Latvian pilots had two other expected counterpart variants. In the second case, the pilots had four options – one correct variant, two expected variants and one unexpected variant for the Norwegian pilots, and one expected and two unexpected variants for the Latvian pilots.

I used some strategies for checking the possibility of other factors, apart from language transfer, being at work. I looked at every word specifically to find out whether the pilots had the same problems with the tested sound in every word or whether they had problems with it only in certain words. It was also important to find out whether there was a bigger difference between the words which were spelled differently or not, as spelling might also play a role in sound perception, and to consider some other possible reasons why the participants' behaviour differed, in the cases where it did.

If the pilots behaved differently with the perception/distinction of the same sound in different words, I checked the tested word groups/pairs according to the following criteria, which might have influenced the respondents' choice: whether the spelling which stood for the tested sound differed in the tested words (perhaps the pilots knew that the particular spelling stood for the tested sound, but not the other spelling), how frequent these words were (maybe one of these words was unfamiliar to the participants, that is why they did not know how to pronounce it), the length of the words (it might be that it was more difficult to perceive the pronunciation of longer words than of the short ones), and how different the Standard British (RP) pronunciation was from the American pronunciation of the same word (nowadays American English is also quite popular, especially among the younger generation, that is why the participants might have been influenced by the American pronunciation of the tested word which might be closer to the incorrect variant of the test).

In order to check how frequent the words were, I used the Corpus of Contemporary American English (henceforth COCA) and the British National Corpus (henceforth BNC). I decided on the COCA because this particular corpus displays most recent data. The COCA contains 450 million words of language samples from fiction, magazines, newspapers and academic writing, and it includes both spoken and written language. I looked at the frequency in the samples taken from the last two years. This subcorpus contains 52 million words.

As I am studying RP, I also included the numbers from the BNC. It was interesting to compare frequencies from both American and British corpora to get more reliable results. The BNC contains a 100 million word collection of samples of written and spoken language from a wide range of sources. I used the data from the latest available edition released in 2007.

I turned to the corpora in cases where both groups of pilots found some words more difficult or easier than the other words tested for the same RP sound, in order to understand whether it was frequency that influenced their decision. The frequency of a word and the pilots' familiarity with the word is of course not one and the same thing. However, I assumed that these two variables were connected and depended on one another, at least to some extent, especially when there are large differences in frequency, such as those for the words *hose* vs. *house* or *pier* vs. *pear*.

I used the t-test to find out whether the results for the Latvians were statistically different from the results for the Norwegians for every tested RP sound. I tested whether the difference between the correct answers of the Latvians and the correct answers of the Norwegians was statistically significant. Then I tested whether the difference between the number of expected answers from the Latvians (in relation to all incorrect answers) and the number of expected answers from the Norwegians (in relation to all incorrect answers) was statistically significant. The purpose was to see whether one group performed more in accordance with the expectations than the other group.

I also measured whether the two groups were equally prone to choose the same sound. I compared each group's choice of the same sound, and whether there was a statistical difference between the two groups with respect to choosing the same sound. If each group of pilots decided on expected sounds more often than the other group, and there was a statistical difference, it would support the idea of transfer. The purpose was also to find out which of these two groups of pilots was more influenced by their L1, and whether the pilots' general language proficiency was

connected to language transfer. My hypothesis was that the lower the general language proficiency is, the more influenced by the L1 the listeners might be.

RP sound /ɜ:/ vs. /æ:/ and /ø:/

The RP sound /ɜ:/ was tested in questions 1, 9 and 17 in the following words: *learn*, *perfect* and *first*. The Latvian pilots were expected to choose the sound /æ:/, while the Norwegian pilots were expected to choose /ø:/ instead. The mid central long vowel phoneme /ɜ:/ does not exist in Latvian and Norwegian. Kaurāte *et al*. (1985: 34) say that Latvian speakers frequently replace /ɜ:/ with the Latvian broad long /æ:/. According to Vanvik (1975: 19), Norwegians tend to round their lips, which results in the /ø:/ sound.

The results show that the Latvian participants had more correct answers (37%) than the Norwegian participants (33%) for this group of sounds. The Norwegian participants chose the expected variant /ø:/ 65% of the time, and the unexpected variant /æ:/ only 2% of the time. Surprisingly, the Latvian test takers decided on the unexpected Norwegian /ø:/ most often (43 % of the time), while the others chose the expected sound /æ:/ (20% of the time). (For detailed information, see appendix 8.)

It was unexpected that the Latvian participants had more correct answers than the Norwegian participants. It had been hypothesized that the Latvians would be worse at perceiving English sounds correctly, as English is not used in Latvia as much as it is used in Norway, the Latvians had less experience with the language (see the discussion of the questionnaire results in section 7.2), and the Latvian vowel phonemes are less similar to the RP vowel phonemes than the Norwegian ones. Although the Latvians performed a little better, the difference was not large, 37% correct for the Latvian vs. 33% for the Norwegian participants, and the difference was not statistically significant (p-value = 0.5770).

Both groups of pilots preferred the Norwegian sound /ø:/. The difference between the number of expected answers from the Latvians (in relation to all incorrect answers) and the number of expected answers from the Norwegians (in relation to all incorrect answers) is extremely statistically significant (p-value = less than 0.0001).

The statistical results show that the Norwegians are more likely to choose the Norwegian sound /ø:/ than the Latvians (the difference is very statistically significant, p-value = 0.0019). As the difference in the choice of /ø:/ is statistically significant, we can say that the pilots are behaving differently with respect to choosing it, and that this is probably because of L1 influence, since the Norwegians use it more.

A possible reason why the Latvians chose the unexpected /ø:/ more often than the expected /æ:/ might be that they have learned that there is an RP /æ/ sound, and they felt the difference between the tested phoneme and the RP /æ/. They might have chosen /ø:/ to mark the contrast. The unexpected result might also be connected to the fact that the phonologist whose voice was recorded for the test lacked any practical knowledge of Latvian, and therefore her /æ:/ was closer to the RP /æ:/ than the Latvian phoneme. As we can see from the contrastive analysis, the position of the /æ:/ is one of the major differences between English / Norwegian (where this phoneme is quite similar) and Latvian (see figure 12 in chapter 4). Even though the Latvian participants behaved differently than expected (they chose the /æ:/ sound, which was closest to their mother tongue, only 20% of the time), the Latvians decided on the /æ:/ ten times more often than the Norwegians: 20% vs. 2%. The difference in the choice of /æ:/ is extremely statistically significant (p-value = 0.0006).

Although the results from the Latvian pilots were not quite as expected, the numbers still seem to support the hypothesis that there is an effect of the L1, as the Norwegians chose /ø:/ more often than the Latvians, and the Latvians chose /æ:/ more often than the Norwegians. As mentioned, three different words were used to test this sound. Interestingly, the results were quite different for the three words. It is therefore worth looking at the words separately and trying to determine what other factors might be playing a role in the results.

The Latvian pilots performed best with the word *l<u>ea</u>rn*: they chose the correct sound 60% of the time, the expected (/æ:/) sound 20% of the time and the unexpected (/ø:/) sound 20% of the time. As for the word *p<u>e</u>rfect*, 40% answers were correct, 13% had the expected (/æ:/) sound and 47% the unexpected (/ø:/) sound. The Latvian pilots demonstrated the worst results with the word *f<u>i</u>rst*: 10% correct, 27% expected (/æ:/) and 47% unexpected (/ø:/).

As regards the Norwegian participants, the difference between the number of right and wrong answers depending on the word was even more remarkable. The Norwegians had 73% correct answers for the word *l<u>ea</u>rn*, 23 % with the expected /ø:/ and 4% with the unexpected /æ:/. However, with the word *p<u>e</u>rfect* the Norwegian pilots answered correctly only 8% of the time, the other chose the expected Norwegian sound (/ø:/) 92% of the time. No one chose the unexpected sound (/æ:/). For the last word of this group, *f<u>i</u>rst*, the Norwegians gave the right answer 19% of the time, decided on the expected (/ø:/) variant 79% of the time and chose the unexpected sound (/æ:/) 2% of the time.

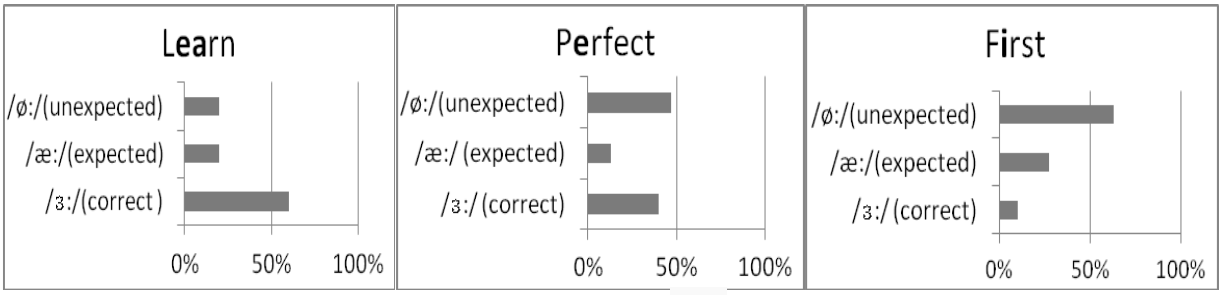


***Figure 25*, Latvian pilots: /ɜ:/, /æ:/ and /ø:/**

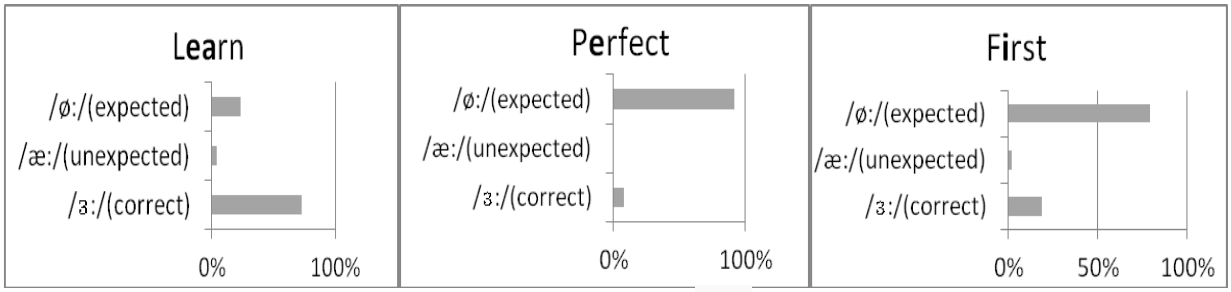


***Figure 26*, Norwegian pilots: /ɜ:/, /æ:/ and /ø:/**

Concerning the distribution of answers for the three words, both groups of pilots had the greatest number of correct answers for the word *learn*. The Latvian participants showed better results with the word *perfect* than with the word *first*, but the Norwegian pilots the other way round. The Latvians had the same number of expected and unexpected variants for the word *learn*, while having more unexpected answers for the other words. It might be that there is something to do with the spelling of these words, i.e. the participants might associate the *ea* spelling with the English sound /ɜ:/, but not the other two spellings, *i* and *e*, which stand for the same sound.

It is unlikely that the pilots are more aware of how to pronounce the word *learn* than the other two words, because all of these words are widely used, and they are almost of the same length. According to the COCA, the frequency of the word *learn* is 132 times per million words, of the word *perfect* 104, and of the word *first* 1145. The BNC says that the frequency of the word *learn* is 83 times per million words, of the word *perfect* 57, and of the word *first* 1227. This shows that the word *learn* is definitely not the most frequently used word out of these three.

The British and American pronunciations of these words differ a little, but the tested sound is pronounced the same way in all the three tested words both in British and American variants: Br. /lɜ:n/, Am. /lɜ˞:n/, Br. /'pɜ:.fekt/, Am. /'pɜ˞:-/, Br. /'fɜ:st/, Am. /'fɜ˞:st/ (*Longman Dictionary of Contemporary English*, 2009). It is therefore unlikely that the difference in pronunciation has influenced the pilots' choice for one particular word but not for the other.

When it comes to the distribution of correct, expected and unexpected answers, the results are not totally random even if we look at each word separately. As mentioned, there is an effect of the L1 seen in the higher number of Norwegians choosing /ø:/ and a higher number of Latvians choosing /æ:/ in all cases. And there also seem to be other factors which influence the participants' choice apart from their L1s, and which seem to be common for the two groups. The findings also reveal that both groups of pilots obviously face problems perceiving the sound /ɜ:/.

RP sound /ʌ/ vs. /a/ and /ø/

The participants listened to the words *subject*, *productive* and *upgrade* in items 2, 10 and 18 to test these sounds. The Latvian pilots were expected to choose the Latvian /a/, but the Norwegians to decide on the Norwegian /ø/. Kaurāte *et al*. (1985: 34) and Laua (1997: 21) say that the Latvian counterpart to the English open central short /ʌ/ is the Latvian /a/, but the Latvian phoneme is more open than the RP one. Vanvik (1975: 16) considers that Norwegians are apt to use not the closest sound /a/ found in their L1, but the sound /ø/.

The Latvians had 47% correct answers, while the Norwegians had 60%. For the rest, the Latvian respondents marked the Latvian /a/ as the correct variant 42% of the time, and the Norwegian respondents 21 % of the time. The Latvians chose the Norwegian sound /ø/ 11% of the time, and the Norwegians 19% of the time. (For detailed information, see appendix 8.)

All in all, with this group of sounds the Norwegian pilots did better than their Latvian colleagues (60% vs. 47%), and the difference between the Norwegians and Latvians is statistically significant (p-value = 0.0397). The Latvian sound /a/ was almost as frequently chosen by the Latvian participants (42%) as the right variant (47%), and two times more often than by the Norwegian participants (21%). The difference between the Latvian and Norwegian pilots with respect to choosing the sound /a/ is extremely statistically significant (p-value = 0.0003). In this case the Latvian participants assimilated their native language sound to the heard sound more often than the Norwegians. As for the Norwegian pilots, the number of participants who chose the expected Norwegian /ø/ and the unexpected /a/ was almost the same – 19% vs. 21%. The difference between the two groups in the choice of /ø/ does not reach statistical significance (p-value = 0.1479).

The difference between the Latvians and Norwegians is extremely statistically significant when it comes to the choice of the expected sounds (p-value = 0.0002). This shows that they chose the expected sounds to different degrees. This can be interpreted to mean that the Latvian group is more influenced by the L1, or rather that the Latvian group behave in line with the

predictions to a greater degree, than the Norwegian group. The explanation could be that the Norwegian /a/ is very close to the Latvian /a/, i.e. it is also a sound present in their mother tongue and the closest sound to the tested one. This sound also seems familiar to the Norwegian ear, and they might be as likely to assimilate the RP /ʌ/ to their /a/ as to their /ø/. Besides, Bird (2005: 84) says that the RP /ʌ/ is more similar to the Norwegian /a/ than anything else. She compares Norwegian *kam* /kam/ and English *come* /kʌm/, and concludes that the Eastern Norwegian pronunciation of *kam* is a perfectly acceptable pronunciation of the English word *come*. Vanvik (1975: 16) writes about how often Norwegians make the mistake of using the /ø/ sound. This mistake could be due to Norwegians thinking that the RP /ʌ/ should be different from the Norwegian /a/, and that the /ø/ is the closest sound out of the remaining sounds.

The Norwegians more frequently chose the /ø/ than the Latvians, which is expected, as the /ø/ is not a part of the Latvian sound system. It should be noted that 11% of the Latvian participants still decided on the Norwegian /ø/. This result shows that there are other universal processes at work which are not dependent on language transfer.

It is possible to see some common features in the pilots' answers. Both groups of participants have problems with the RP sound /ʌ/. While the Latvian participants more often confused the English sound with its Latvian counterpart, the Norwegian participants mixed it with the Norwegian /ø/ and with the Norwegian/Latvian /a/ to the same extent. The fact that they mixed it with the /a/ also points to language transfer. These findings support my hypotheses, but also indicate that there are other universal factors which may interact.

In this group of tested sounds, the results for each separate word also differed. Both Latvians and Norwegians demonstrated the worst results with the word *subject*. The Latvian participants chose the correct sound only 24% of the time, and the Norwegians 31% of the time. Among the others, the Latvian pilots preferred the Latvian /a/ sound 73% of the time, and the Norwegians 38% of the time, while the Latvian respondents decided on the Norwegian /ø/ sound 3% of the time, and the Norwegian respondents 31% of the time. The Latvians had an approximately even distribution between the other two words, *productive* and *upgrade*: they chose the correct sound /ʌ/ 67% and 50% of the time, the expected sound /a/ 26% and 27% of the time, and the unexpected Norwegian /ø/ 7% and 23% of the time. The Norwegian test takers chose the Norwegian /ø/ in the word *productive* only 7% of the time, while the other decided on the /a/ 23% of the time. The results turned out to be different with the word *upgrade*: they went for the Norwegian /ø/ 17% of the time, and marked the /a/ only 4% of the time.

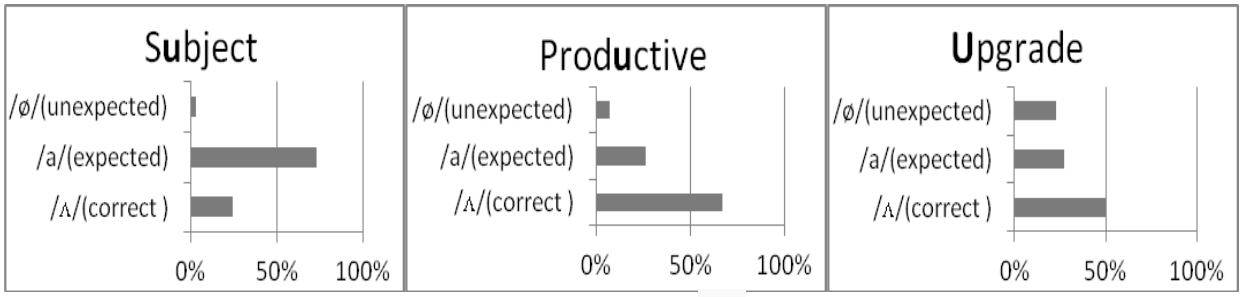


***Figure 27*, Latvian pilots: /ʌ/, /a/ and /ø/**

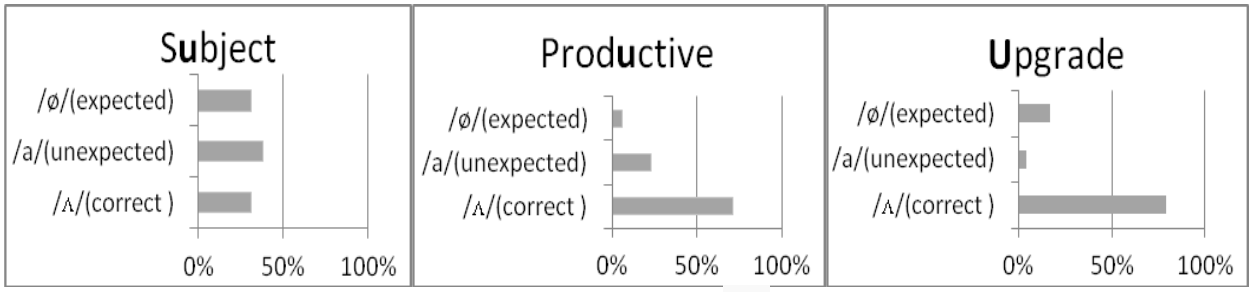


***Figure 28*, Norwegian pilots: /ʌ/, /a/ and /ø/**

If we look at the three tested words, the results for each word are different for both groups of pilots. The participants showed the worst results for the word *subject*. The results of the Norwegian respondents were contradictory for the words *productive* and *upgrade* as regards the choice of the expected and unexpected sounds. Spelling may sometimes play tricks on what people think they hear or what they expect a word to sound like, but in this situation it is not the case, as all the tested words have the same letter *u* which corresponds to the tested RP sound. The only difference is that the spelling of the third word starts with this letter, and, thus, it could be more easily noticed. This might have been advanced as an explanation why the Norwegian pilots had the best results for this word, but since the Latvian participants do not show the same pattern, it is less likely that this is the reason.

The word *subject* was the most problematic word for both groups of pilots. However, the word *subject* is not the least frequently used word out of the ones tested. The COCA says that the word *subject* is used with the frequency of 89 times per million words, the word *productive* 14, and the word *upgrade* 8. The BNC shows approximately the same results: the word *subject* is used with a frequency of 234 times per million words, the word *productive* 14, and the word *upgrade* 7. Hence, we cannot explain the participants' errors with the fact that they were less familiar with the word *subject*. Moreover, the word is not longer than the other two words, and the pronunciation of all the tested words is the same in British and American varieties (*Longman Dictionary of Contemporary English*, 2009).

RP sound /ə/ vs. /æ/ and /e/

Items 3, 11 and 19 were designed to test these sounds in the words *manoeuvre*, *suffer* and *beginner*. It was hypothesized that the Norwegian pilots would decide on the right variant /ə/, but the Latvians would give preference to the Latvian /æ/ or /e/. The charts of the Latvian sound system by Grigorjevs (2008: 199) indicate that the Latvian sounds closest to the RP schwa are the /æ/ and /e/, but especially the /æ/. As for Norwegians, they have a sound which is close to the RP schwa, though it is not as central as the RP phoneme, which appears only in unstressed positions. Linguists describing Norwegian learners of English (Bird, 2005: 83–84; Vanvik, 1975: 12) do not speak about the RP schwa as problematic.

The findings reveal that the most frequently chosen sound by both groups of pilots was the sound /æ/: the Latvian participants thought it was the right variant 48% of the time, and the Norwegian participants 53% of the time. The Latvian pilots recognized the right RP sound only 35% of the time, and the Norwegian pilots only 41% of the time. The rest Latvians and Norwegians chose the sound /e/ (17% and 6% of the time). (For detailed information, see appendix 8.)

Both groups of pilots had correct responses less than 50% of the time, and the difference between these numbers does not reach statistical significance (p-value = 0.3841). This means that both groups of participants have pronounced difficulties with the RP sound /ə/. The Norwegian respondents showed unexpected results. Most of them marked the sound /æ/ as correct, which was not the closest sound to the schwa in their native language. Therefore, the difference between the number of the counterpart sounds chosen by the Latvians (in relation to all incorrect answers) and the number of the counterpart sounds chosen by the Norwegians (in relation to all incorrect answers) is extremely statistically significant (p-value = 0.0003). The difference between the two groups with respect to choosing the /æ/ does not reach statistical significance (p-value = 0.3987). Even though the Norwegian schwa is not as central as the RP one, it was supposed that Norwegians would have fewer problems with the schwa than Latvians, as this sound might not seem unfamiliar to their ears. The fact that the Latvians had problems with the schwa was according to the hypothesis.

When it comes to the choice of /æ/ for the schwa by both Latvians and Norwegians, the more open pronunciation of the final schwa for some English speakers could have influenced their choice of the /æ/ over the /e/. The Norwegians might have mistaken the Latvian /æ/ for the RP schwa also because the Latvian /æ/ is much closer to the RP schwa than the Norwegian /æ/ is

(see figure 12 in chapter 4). As Norwegians were not used to the Latvian /æ/, they might have taken it for the English /ə/.

Even though none of the groups of participants chose the sound /e/ very often, the Latvians chose this sound more often than the Norwegians, and the difference between the Latvians and Norwegians with respect to choosing this phoneme is very statistically significant (p-value = 0.0068). This means that in this case the Latvians are more influenced by their mother tongue than the Norwegians.

When we look at the separate words, we see that both groups of pilots had difficulties with the word *manoeuvre*: the Latvian test takers gave the correct answer only 13% of the time, and the Norwegian test takers only 15% of the time, the Latvian respondents chose the sound /e/ 27% of the time, and the Norwegian respondents 13% of the time. The Latvians decided on the /æ/ 60% of the time, and the Norwegians 72% of the time.

As many as 53% of the Latvian and 35% of the Norwegian participants answered correctly when listening to the word *suffer*. None of the Latvians chose the sound /e/, and the Norwegians chose this sound only 7% of the time. The Latvians marked the option with /æ/ 47% of the time, and the Norwegians 65% of the time.

When it comes to the word *beginner*, the Latvian test takers provided the correct answer 40% of the time, and the Norwegian test takers 73% of the time, they chose the /e/ 23% and 4% of the time, and decided on the /æ/ 37% and 23% of the time.

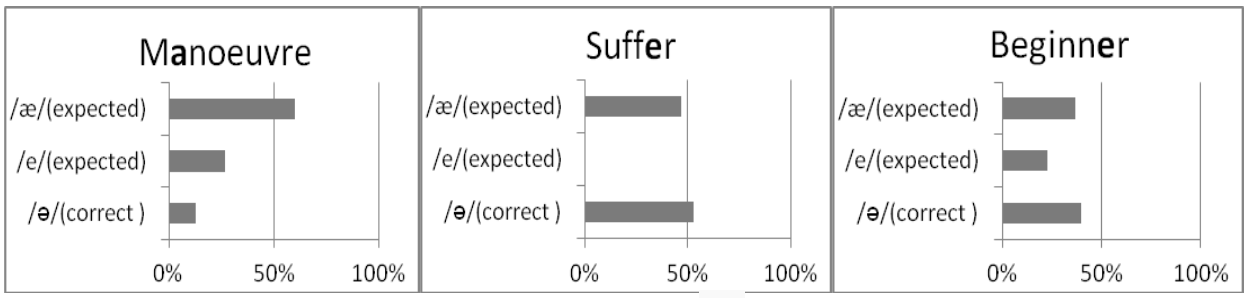


***Figure 29,* Latvian pilots: /ə/, /e/ and /æ/**

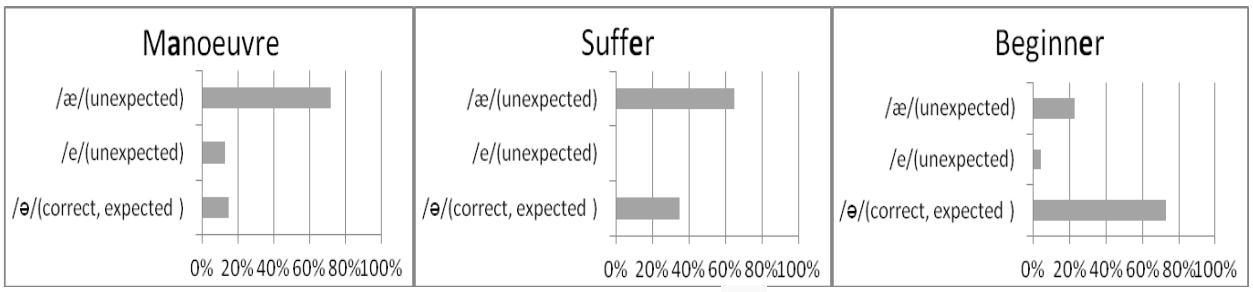


***Figure 30,* Norwegian pilots: /ə/, /e/ and /æ/**

Regarding the separate words, both groups of pilots made the largest number of mistakes with the word *manoeuvre*. The tested sound in the words *manoeuvre*, *suffer* and *beginner* is the same in British and American English, but in American English the /ə/ is rhotic in the words *suffer* and *beginner*, and in British English it is not: Br. /ˈsʌf.ə/, Am. /ˈsʌf.ɚ/, Br. /bɪˈgɪn.ə/, Am. /bɪˈgɪn.ɚ/ (*Longman Dictionary of Contemporary English*, 2009). This difference might have played a role in the respondents' choice if the situation was opposite, – there was a difference in pronunciation of the most problematic word. In this case we would think that the American variant could have influenced the pilots' decisions.

Perhaps the pilots were confused because *manoeuvre* is a French loan word, and they were not sure how to pronounce it. The word *manoeuvre* is not used as frequently as the other two tested words in American English. The COCA shows that the frequency of the word *manoeuvre* is 0.3 times per million words, while the frequencies of *suffer* and *beginner* are 23 and 4. According to the BNC, the frequency of the word *manoeuvre* is 6 times per million words, while the figures for *suffer* and *beginner* are 35 and 3 respectively. Even though the word *manoeuvre* seems to be used more often in the British corpus than in the American corpus, it is not used as often as the word *suffer*.

Furthermore, the tested schwa is spelled differently in the word *manoeuvre* than in the words *suffer* and *beginner*, which have a spelling that might be more familiar to the participants. It might be that the pilots are used to the weakening of the ending in English words, but do not really understand how the letter *a* in the word *manoeuvre* should be pronounced. This word has a long, unusual and complicated spelling overall. The combination of the three vowels, *oue*, in the word might already look frightening to the respondents.

However, we cannot assume that these are the only reasons why the results are so poor, because the participants made many mistakes also in the other two words which are quite widely used in English. As for the other two words, there is no clear pattern in the respondents' choices, as the Latvians knew better how the word *suffer* should sound, but the Norwegians made fewer mistakes with the word *beginner*.

RP diphthong /ɪə/ vs. /iə/ and /eə/

These diphthongs were tested in questions 4, 12 and 20 in the words *gear*, *year* and *here*. The Latvian participants were expected to decide on the /iə/, while the Norwegians on the /eə/ instead. Kaurāte *et al*. (1985: 41–42) notes that Latvian learners frequently substitute the English

/ɪ/ in the /ɪə/ with the Latvian /i/, without opening the mouth and advancing the jaw. Vanvik (1975: 26) says that the RP diphthong /ɪə/ is often perceived as /eə/ by Norwegian ears.

The total percentage of correct answers was fairly similar for both groups of respondents: 31% for the Latvian and 30% for the Norwegian pilots. The answers of the Latvian participants were distributed almost equally between the three possible options: they chose the expected /iə/ 31% of the time, and the unexpected /eə/ 38% of the time. As for the Norwegian participants, the majority preferred the expected diphthong /eə/ (they chose it 62% of the time), while the rest marked the unexpected sound /iə/ as what they believed to be the right answer (8% of the time). (For detailed information, see appendix 8.)

Both groups of pilots showed poor results for this group of sounds, and the difference between the correct answers of the Latvian and the correct answers of the Norwegian respondents was not statistically significant (p-value = 0.8297). The participants in each group recognized the right pronunciations of the given words in less than one third of the cases. These findings indicate that the pilots have problems with the diphthong /ɪə/, as hypothesized. Surprisingly, even though both elements of the Latvian diphthongs are fully pronounced, and Latvians do not have the schwa, the Latvian participants did not demonstrate worse results than the Norwegian participants, whose unstressed *e* is similar to the RP schwa and who are used to the weakening of the second diphthong element.

Most of the participants confused the RP /ɪə/ with the diphthong /eə/, though the Norwegians to a higher extent, as predicted (62% for the Norwegian vs. 38% for the Latvian pilots), and the difference between the number of expected answers of the Latvian group (in relation to all incorrect answers) and the number of expected answers of the Norwegian group (in relation to all incorrect answers) is extremenly statistically significant (p-value = less than 0.0001). Regarding the Latvian pilots, it is unexpected that they preferred a sound which does not exist in their mother tongue to the sound /iə/, which is closer to the Latvian /ie/. One explanation might be that the starting point of the /eə/ is actually almost as close to the starting point for /ɪə/ as the Latvian /i/ is.

All in all, even if it is not easy to explain the results, they do partly correspond to the hypotheses. As predicted, the RP diphthong /ɪə/ created problems for the Latvian and Norwegian pilots. The Norwegian pilots chose the /eə/ most of the time, and they chose this option more often than the Latvians. The results indicate that the Norwegians preferred the /eə/ statistically more often than the Latvians (p-value = 0.0003). While the Latvians chose the expected

diphthong /iə/ only around one third of the time, the Latvians decided on this variant almost four times more often than the Norwegians, and the difference between the Latvians and Norwegians with respect to choosing the /iə/ is extremely statistically significant (p-value = less than 0.0001).

Out of the three tested words, the word *gear* received the largest number of correct answers: the Latvian pilots chose the right pronunciation 50% of the time, and the Norwegian pilots 58% of the time. For this word, the Latvian speakers decided on the expected diphthong /iə/ 37% of the time, and chose the unexpected diphthong /eə/ 13% of the time. There were not so many Norwegian participants who chose the sound /iə/ (they chose it just 2% of the time). The other Norwegian respondents preferred the expected /eə/ (40% of the time).

The situation with the other two words was even worse. The Latvian test takers gave the right answer for the word *year* only 20% of the time, and the Norwegian test takers only 11% of the time. The Latvians chose the diphthong /iə/ 10% of the time, and the Norwegians 4% of the time. The Latvians decided on the diphthong /eə/ 63% of the time, and the Norwegians 85% of the time. The Latvian pilots recognized the right pronunciation of the word *here* only 17% of the time, and the Norwegian pilots only 21% of the time. The other Latvian and Norwegian participants chose the sound /iə/ (46% and 19% of the time), and the sound /eə/ (37% and 60% of the time).

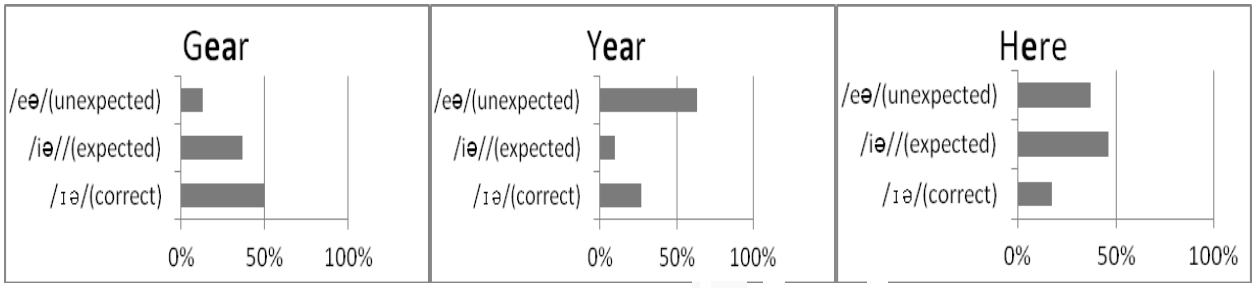


***Figure 31*, Latvian pilots: /ɪə/, /iə/ and /eə/**

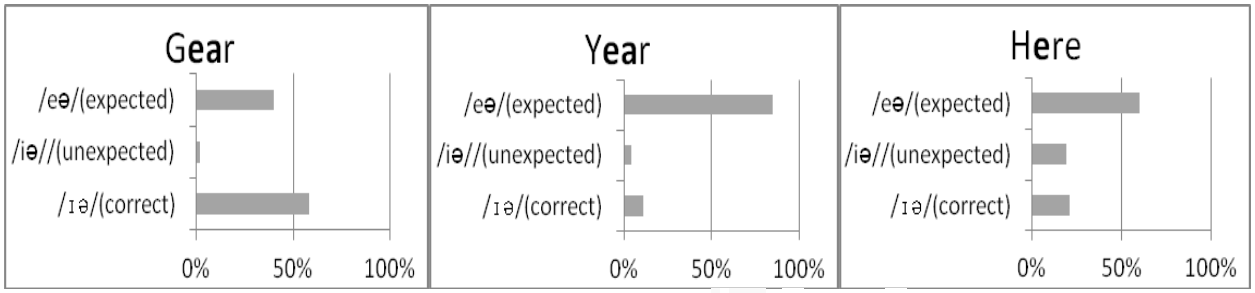


***Figure 32*, Norwegian pilots: /ɪə/, /iə/ and /eə/**

It is not obvious why both groups of pilots had the greatest number of right answers for the word *gear*. *Gear* is a technical term, and the pilots may hear it quite often when they are on duty, but the other two words, *year* and *here*, are words of everyday use. In the COCA we see that the words *year* and *here* are used much more often: the word *gear* appears 4 times per million words, but the words *year* and *here* 751 and 1048 times respectively. The BNC gives approximately the same difference in frequencies: 19 instances per million words for the word *gear*, and 743 and 690 for the words *year* and *here*. The spelling which corresponds to the tested diphthong is the same for *gear* and *year*. It does not seem that it was the spelling which played a decisive role in the pilots' choice of pronunciation. The length of these words does not differ either. While the tested diphthong is found only in RP, the American pronunciation was unlikely to play any role in the participants' decisions, as Americans substitute the RP /ɪə/ by the monophthong /ɪ/ + /r/ in all of these cases, but not in all words with /ɪə/ (*Longman Dictionary of Contemporary English*, 2009). However, *year* has an alternative RP pronunciation with /ɜ:/ (/jɜ:/) which may (at least partly) explain the results for this word (Stenbrenden, 2012: personal communication).

RP diphthong /eə/ vs. /æə/, /æ:ə/ and /e:ə/

This group of sounds was tested in items 5, 13 and 21 in the words *where*, *there* and *aircraft*. The Latvian respondents were expected to confuse the diphthong /eə/ only with the /æə/, while the Norwegian participants with both /æ:ə/ and /e:ə/. According to Kaurāte *et al*. (1985: 41–42), Latvian learners often substitute the English /eə/ with the Latvian /æə/. Vanvik (1975: 26) says that Norwegians use the Norwegian /e:/ or /æ:/ as a starting point for the English /eə/.

The majority of the participants did not have problems recognizing the RP /eə/: the Latvian pilots decided on the right pronunciation 64% of the time, and the Norwegian pilots 79% of the time. The Latvians chose the /æə/ 15% of the time, and the Norwegians 4% of the time. The Latvians marked the /e:ə/ 18% of the time, and the Norwegians 17% of the time, and the /æ:ə/ 3% and 0% of the time. (For detailed information, see appendix 8.)

The Norwegian participants showed better results with this group of sounds than the Latvians, as predicted, and the difference between the correct responses provided by the Norwegians and the correct responses provided by the Latvians reaches statistical significance (p-value = 0.0208). The Latvian language contains only strong, distinct and fully-pronounced diphthongs, which is one of the reasons it was hypothesized that it would be difficult for Latvians to recognize RP diphthongs, especially centring ones. Even though the Latvian linguists

Kaurāte *et al*. (1985: 41–42) say that the RP diphthongs /ɪə/ and /eə/ are the most difficult for Latvians, neither the Latvian nor the Norwegian pilots had as many problems with the RP /eə/ as with the other sounds described above. The reason could be that the linguists discussed mainly production, whereas I tested perception.

The second most frequently chosen answer after the right one was the sound /e:ə/. As Vanvik (1975: 26) rightly said, Norwegians tend to mix the sounds /eə/ and /e:ə/. The reason probably is that the RP /e/ is very close to the Norwegian /e:/. However, the Norwegian sound /e/ is still closer to the beginning of /eə/ than the /e:/ is. The Latvian participants also often confused /eə/ with /e:ə/, and the difference between the two groups in the choice of /e:ə/ is not statistically significant (p-value = 0.9408). Even though it was not an expected variant for the Latvians, it is not so strange that they decided on this option, as the RP /e/ is not very far from the Latvian /e:/ either. But the Latvian /e:/ is no closer to the beginning of the /eə/ than is the Latvian /e/.

The difference between the number of expected answers of the Latvians (in relation to all incorrect answers) and the number of expected answers of the Norwegians (in relation to all incorrect answers) is not statistically significant either (p-value = 0.0754). This means that we cannot disproove the null hypothesis, which in this case would be that both groups behaved according to expectations to the same extent.

The third most frequently chosen sound was the sound /æə/. The Latvians decided on this variant more often than the Norwegians, as predicted, and the difference between the Latvian and Norwegian pilots with respect to choosing this sound reaches statistical significance (p-value = 0.0137). This sound was chosen by the Latvian participants almost as often as the sound /e:ə/. The complication might be that the phonologist who recorded the test had only a theoretical knowledge of Latvian, and she might have read the words using the /æ/ which is closer to the Norwegian or English sound rather than the Latvian one. It follows from the charts that the /æ/ sounds are different in all the three languages (see figure 12 in chapter 4). If the authentic Latvian sound was used, it might have influenced the choice of the Latvian pilots in favour of the sound /æə/.

Vanvik also mentioned that it is usual for Norwegians to confuse /eə/ with /æ:ə/. Nevertheless, the results show that none of the 48 Norwegian pilots made this mistake. However, the Latvians chose the sound /æ:ə/ 3% of the time. The difference in numbers between the two groups with respect to choosing the /æ:ə/ is not quite statistically significant (p-value = 0.0881). The Latvian and Norwegian sounds /æ:/ are not the closest counterpart sounds to the first

element of the diphthong /eə/ found in their native languages, but especially the Norwegian sound is much more open and front than the first element of the tested diphthong.

If we look at the general picture, the pilots did not have as many problems with the diphthong /eə/ as expected. The Norwegian pilots made fewer mistakes than the Latvian pilots, as hypothesized. The most frequent Norwegian mistakes was the expected sound /e:ə/, but not the second expected sound /æ:ə/. Even though the Latvians made the unpredicted mistakes by also choosing the sound /e:ə/, they chose the sound /æə/, which is the closest sound for Latvians, almost four times more often than the Norwegians, and the difference between the two groups in the choice of /æə/ is statistically significant. In case of the Latvian participants, the statistical difference goes in the expected direction and supports the idea of transfer.

The results for each separate word do not differ much from one another. The Latvian pilots gave the right answer for the word *where* 60% of the time, for the word *there* 73% of the time, and for the word *aircraft* 60% of the time. The diphthong /æə/ was chosen by the Latvians in the word *where* 10% of the time, in the word *there* 14% of the time and in the word *aircraft* 20% of the time. The sound /e:ə/ was chosen by the Latvians in the word *where* 27% of the time, in the word *there* 10% of the time and in the word *aircraft* 17% of the time. Finally, the Latvian participants chose the sound /æ:ə/ in all of the tested words 3% of the time.

The Norwegian respondents performed better with the words *there* and *aircraft* than with the word *where*: they gave the right answers for both of these words 90% of the time. As regards the word *where*, the Norwegian test takers answered correctly only 58% of the time. The second most popular sound chosen by the Norwegians was the diphthong /e:ə/: they marked it as a right variant in the word *where* 33% of the time, in the word *there* 10% of the time and in the word *aircraft* 8% of the time. Not many Norwegian participants chose the unexpected /æə/: they chose it in the word *where* 9% of the time, in the word *there* 0% of the time, and in the word *aircraft* 2% of the time. No one confused the tested RP sound with the diphthong /æ:ə/.

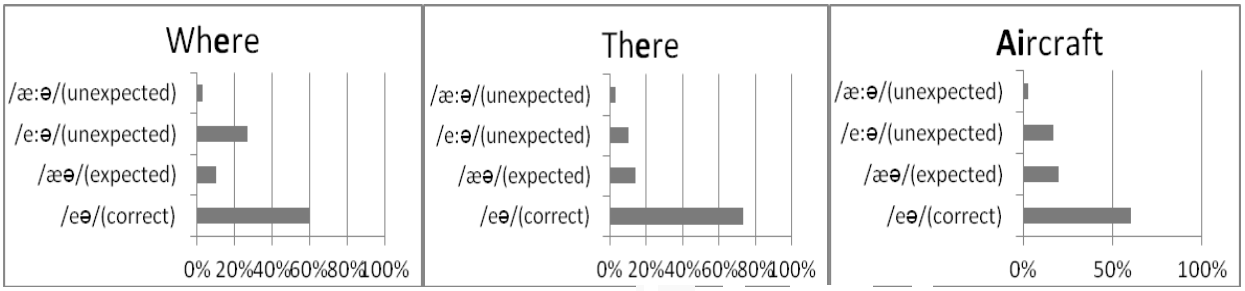


***Figure 33*, Latvian pilots: /eə/, /æə/, /e:ə/ and /æ:ə/**

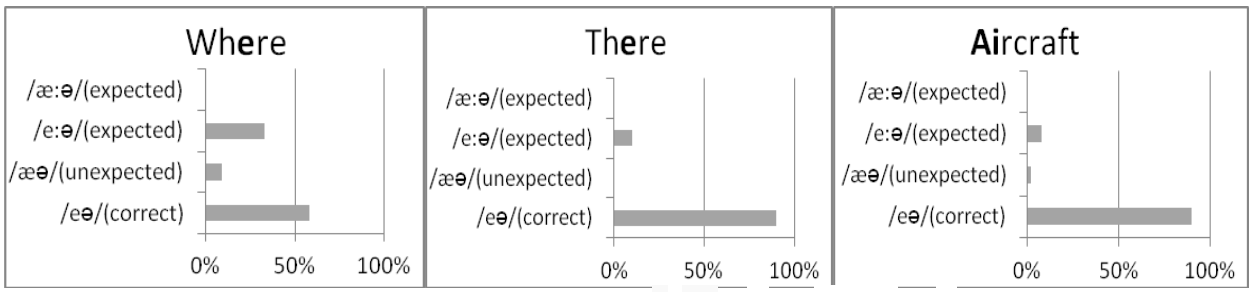


***Figure 34*, Norwegian pilots: /eə/, /ææ/, /eːə/ and /æːə/**

Interestingly, the Norwegian participants demonstrated the worst results with the word *where* (only 58% correct answers), while they had 90% correct responses for the words *there* and *aircraft*. The spelling of the words *where* and *there* is the same, and we cannot say that one word is more familiar to the participants than the other. According to the COCA, the word *where* appears 1046 times per million words, the word *there* 2670 times, but the word *aircraft* only 23 times. The BNC says that the frequency of the word *where* is 1074 times per million words, and the figures for *there* and *aircraft* are 3247 and 63 respectively. Even though the British and American pronunciations differ, the American variant of the word *where* and *there* is the same: /wer/ and /ðer/ (*Longman Dictionary of Contemporary English*, 2009). Thus, accent variation does not explain the difference in the correct answers for these two words. The results of the Latvian pilots did not differ much when it comes to the individual words.

RP diphthong /ʊə/ vs. /uo/ and /ʉ/

The recordings of the words *Europe*, *secure* and *plural* were played for the participants in items 6, 14 and 22 to test these sounds. It was predicted that the Latvian pilots might confuse /ʊə/ with the Latvian diphthong /uo/, but the Norwegian pilots with the Norwegian sound /ʉ/. It follows from the vowel chart based on the description of the Latvian diphthongs by Kaurāte *et al*. (1985: 37–44), that the closest Latvian counterpart for the English /ʊə/ is the Latvian /uo/. Dirdal (2012: personal communication) says that Norwegians often replace the /ʊə/ with the Norwegian phoneme /ʉ/. Dirdal (*ibid*.) and Vanvik (1975: 26) mention that sometimes Norwegians also use the Norwegian sound /ɔː/ for the tested diphthong. This sound is not included in the test, as it may be used also by native speakers in some cases.

The Norwegian test takers showed better results than their Latvian colleagues; however, both groups of pilots had obvious difficulties recognizing the right RP variant: the Latvian respondents gave the correct answer 27% of the time, and the Norwegian respondents 58% of the time. For the rest, the Latvians chose the Latvian diphthong /uo/ 50% of the time, and the

Norwegians 20% of the time. The Latvians chose the Norwegian sound /ʉ/ 23% of the time, and the Norwegians 22% of the time. (For detailed information, see appendix 8.)

The Norwegian participants did better than the Latvian participants as regards the tested diphthong, as expected, and the difference between the Norwegians and Latvians is extremely statistically significant (p-value = less than 0.0001). The Latvian pilots were expected to have more problems not only with the perception of the RP sounds in general, but especially with the perception of the RP diphthongs, which are less distinctly pronounced than the diphthongs of their mother tongue.

The wrong responses of the Norwegian pilots were evenly divided between the unexpected sound /uo/ and the expected sound /ʉ/ (20% vs. 22%), while the Latvian pilots preferred the expected /uo/ over the unexpected /ʉ/ (50% vs. 22%), and the difference between the number of expected answers provided by the Latvians (in relation to all incorrect answers) and the number of expected answers provided by the Norwegians (in relation to all incorrect answers) is extremely statistically significant (p-value = 0.0005).

Probably, the Latvian diphthong /uo/ seems to be closer to the tested RP diphthong to Latvians and Norwegians, as the Latvian respondents decided on this variant most of the time, and the Norwegian pilots were also prone to choose this option quite often (even though this sound is not a part of the Norwegian sound system). This might be due to the fact that the /uo/ is a diphthong, like /ʊə/, whereas /ʉ/ is a monophthong. However, if we compare the numbers in each group who chose /uo/ and the numbers in each group who chose /ʉ/, we will see that the Latvians chose their expected sound more often than the Norwegians, and the difference is extremely statistically significant (p-value = less than 0.0001). The difference between the two groups with respect to the choice of the Norwegian /ʉ/ does not reach statistical significance (p-value = 0.7406). This can be interpreted to mean that the Latvian group tends to assimilate the sounds of their native language to the RP sounds to a larger degree than the Norwegian group.

The findings show that the Latvian and Norwegian pilots have difficulties with the perception of the RP /ʊə/ and tend to confuse it with both /uo/ and /ʉ/. It seems from the results that there is some effect of the L1s on the choice of the participants. The Latvian respondents gave preference to the distinct, fully pronounced diphthong of their mother tongue most often. Even though the Norwegian test takers chose their native sound to the same extent as the unexpected diphthong, they did it more often in comparison to the second incorrect option than their Latvian colleagues.

As for the individual words, most of the correct responses were chosen for the word *secure*: the Latvian pilots chose the right option 43% of the time, and the Norwegian pilots 79% of the time. The Latvian participants marked the Latvian diphthong /uo/ as correct 47% of the time, and the Norwegian participants 4% of the time. The Latvian participants decided on the Norwegian /ʉ/ 10% of the time, and the Norwegian participants 17% of the time.

Regarding the other two tested words, the Latvians did better with the word *plural*, and the Norwegians with the word *Europe*. The word *plural* received 27% correct answers on the part of the Latvians and 44% correct answers on the part of the Norwegians, whereas the Latvian pilots chose the right RP sound in the word *Europe* 10% of the time, and the Norwegian pilots 52% of the time. The other chosen options for these two words did not have any clear pattern. The Latvians decided on the diphthong /uo/ in the word *plural* 30% of the time, and the Norwegians 56% of the time, but the Latvians chose the same diphthong in the word *Europe* 73% of the time, and the Norwegians only 6% of the time. When it comes to the last option for these two words, the Norwegian sound /ʉ/, the answers were unsystematic either: the Latvian participants decided on this option in the word *plural* 43% of the time, and none of the Norwegian participants decided on this option, while the Latvians chose this variant in the word *Europe* 17% of the time, and the Norwegians 42% of the time.

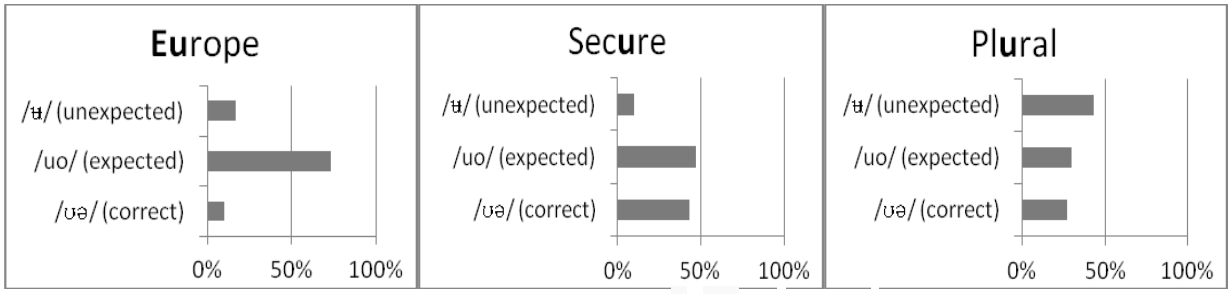


***Figure 35*, Latvian pilots: /ʊə/, /uo/ and /ʉ/**

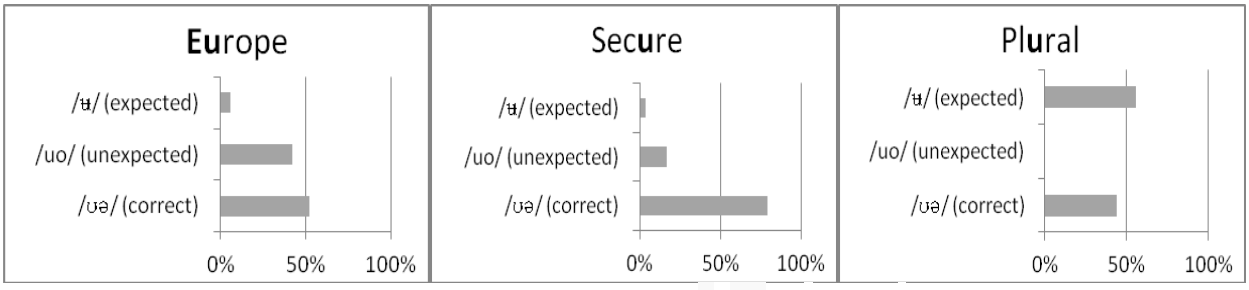


***Figure 36*, Norwegian pilots: /ʊə/, /uo/ and /ʉ/**

Both groups of pilots demonstrated the best results with the word *secure*. This word does not seem to be more frequent than the other two tested words. In the COCA, the word *Europe* occurs 89 times per million words, the word *secure* occurs 36 times per million words, and the word *plural* 2 times. In the BNC, the word *Europe* appears 183 times per million words, the word *secure* 46 times, and the word *plural* 4 times. The word *secure* seems to come between the other two words in terms of its frequency in both corpora. The spelling of the tested sound in the word *secure* is the same as in the word *plural*, but not the same as in the word *Europe*. This means that the spelling difference cannot be the reason why the RP pronunciation of the word *secure* was recognized more easily. In a further attempt to find an answer for this question I looked at the difference between the RP and American pronunciations of the tested words. It did not help either, as the American variant of the diphthong /ʊə/ is /ʊ/ + /r/ in all the three cases (*Longman Dictionary of Contemporary English*, 2009). All the three tested words are of the same length. It might be that the pilots come across *secure* more often than the other tested words (*airport security*, *security*, *secure*…). However, it was hard to give any reasonable explanation why the Latvians and the Norwegians performed differently with the other two tested words.

We can note that the choice of the tested sounds differs a lot when it comes to individual words, and so far it is not clear what the pilots' choice depends on.

RP sound /ɒ/ vs. /ɔ/

The words *problem*, *hot* and *top* were recorded with the two tested sounds. These words are found in items 7, 15 and 23. Both Latvian and Norwegian participants were expected to choose the /ɔ/ instead of the RP sound /ɒ/. Linguists describing Latvian learners (Kaurāte *et al*., 1985: 30; Laua, 1997: 20; Roach, 2009: 14) unanimously agree that Latvians tend to use the Latvian /ɔ/ for the open back short English /ɒ/. The Latvian phoneme is much closer than the English /ɒ/. The Norwegian counterpart for the RP /ɒ/ is the Norwegian /ɔ/ (Popperwell 2010: 26). The Norwegian /ɔ/ is closer than the RP /ɒ/, but it is still not as close as the Latvian /ɔ/.

The Latvian and Norwegian test takers chose the right RP sound /ɒ/ half of the time (52% and 49% of the time). The others decided on the wrong variant. (For detailed information, see appendix 8.)

Although it was hypothesized that Latvians would have more problems with the RP sounds in general, it is not the case with this sound pair, and the difference between the Latvians and Norwegians is not statistically significant (p-value = 0.6115). The results of the Latvian and Norwegian participants indicate that they do not distinguish between the RP /ɒ/ and /ɔ/ of their

mother tongues, as half of the participants from each group chose the wrong variant. There could be multiple factors why the Latvian and Norwegian pilots have problems distinguishing between the /ɒ/ and /ɔ/. It might be that the tested sound is assigned to the wrong category of the native sounds by both groups of pilots. (The difference between the Latvians and Norwegians is not statistically significant as regards the choice of the expected sound, p-value = 0.6115).

The two groups of pilots demonstrated opposite results as regards each separate word. The Latvian pilots showed the best results with the word *problem* (67% correct answers), than with the word *hot* (50% correct answers), and the worst results with the word *top* (40% correct answers). The Norwegian participants, on the contrary, had the greatest number of right responses for the word *top* (63%), than for the word *hot* (46%), and the lowest number of right responses for the word *problem* (38%).

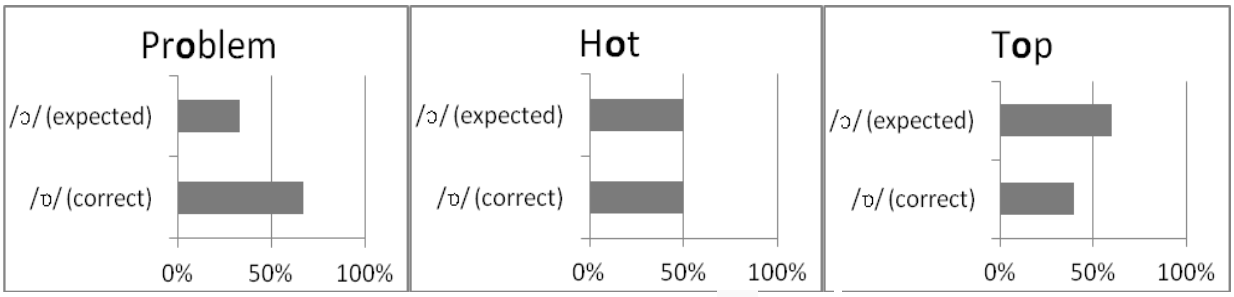


***Figure 37*, Latvian pilots: /ɒ/ and /ɔ/**

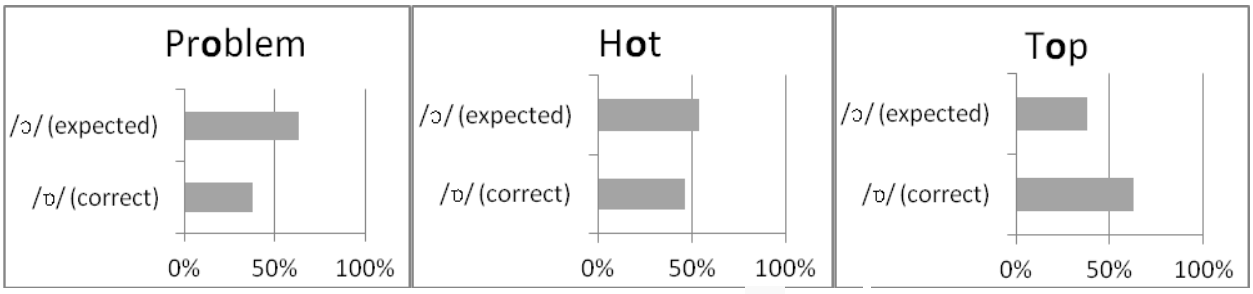


***Figure 38*, Norwegian pilots: /ɒ/ and /ɔ/**

The correct and incorrect answers were not evenly distributed between the three tested words, but the difference in percentages was not that great. The percentages of correct answers given by the Latvian respondents varied between 67% and 40%, and the figures of the Norwegian participants between 63% and 38%. Moreover, the word which turned out to be the most difficult for the Latvian pilots appeared to be the easiest for the Norwegian pilots, and vice versa. These findings might indicate that both groups of pilots had difficulties recognizing the right RP sound regardless of the spelling and length of the word it appears in.

RP sound /ɑ:/ vs. /a:/

The pilots were asked to listen to the words *start*, *after* and *largely* in items 8, 16 and 24, and to mark the right RP variant. It was predicted that both Latvians and Norwegians might choose the /a:/ instead of the RP /ɑ:/. The RP /ɑ:/ is a back sound, while its Latvian and Norwegian counterparts are central or front sounds (Kaurāte *et al*., 1985: 29–30; Laua, 1997: 21; Popperwell, 2010: 24). The Latvian and Norwegian /a:/ sounds are very similar.

Even though both groups of pilots made some mistakes, the participants gave the right answers for these items most of the time: the Latvian respondents recognized the correct RP pronunciation 73% of the time, and the Norwegian respondents 82% of the time. The other participants chose the Latvian and Norwegian counterpart sound /a:/. (For detailed information, see appendix 8.)

Speaking about the production of the tested RP sound, neither Nilsen (2010) nor Vanvik (1975) say that this sound cause particular difficulties for Norwegian learners of English. As for the Latvian linguists, Kaurāte *et al.* (1985: 29–30) and Laua (1997: 21) mention that Latvian learners face special difficulties when producing the RP /ɑ:/, as its articulation is more retracted and open than the articulation of its Latvian counterpart. According to the results of the present study, the difficulties which Latvians have with the production of the RP /ɑ:/ do not concern its perception. At least both Latvian and Norwegian participants demonstrated better results with the perception of the RP /ɑ:/ than with the perception of all the other RP sounds tested in the first part of this study. The Norwegian pilots performed a little better than the Latvian pilots, as hypothesized, but the difference between the two groups is not statistically significant (p-value = 0.1429).

The findings show that the pilots do not have much of a problem differentiating the RP /ɑ:/ from the /a:/, which is the counterpart of the tested sound present in their mother tongues. However, the Latvian participants made mistakes in favour of their counterpart sound around 1/4 of the time, and the Norwegian participants around 1/5 of the time (the difference between the number of counterpart sounds chosen by the Latvians (in relation to all incorrect answers) and the number of counterpart sounds chosen by the Norwegians (in relation to all incorrect answers) is not statistically significant, p-value = 0.1429). This might indicate that even though the pilots are well aware of how the target sound is pronounced, they still cannot always distinguish it from the native sound they are used to. On the other hand, we cannot be absolutely sure that it is

language transfer that influences the participants' decisions. It might also be a human factor or universal strategies, or other reasons.

The Latvian and Norwegian test takers made mistakes in the word *start* most often: the Latvians chose the right RP sound only 53% of the time, and the Norwegians only 58% of the time. There was a slight difference in the responses for the words *after* (80% correct answers) and *largely* (87% correct answers) for the Latvian participants, and no difference between these two words for the Norwegians (both words received 94% correct answers).

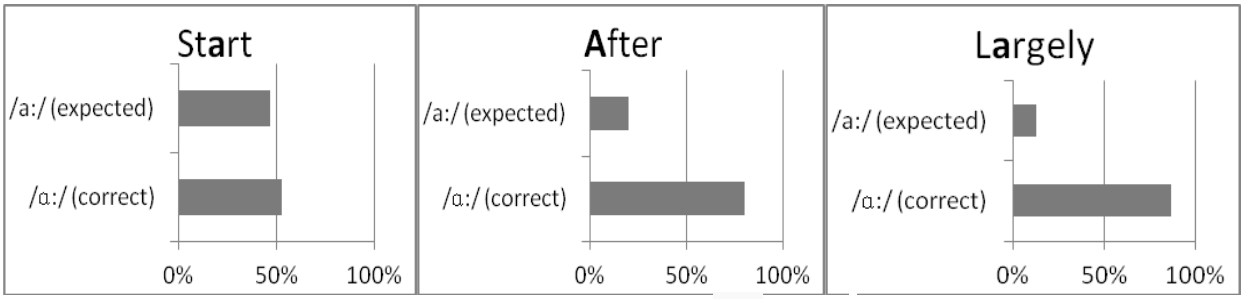


Figure 39, **Latvian pilots: /ɑ:/ and /a:/**

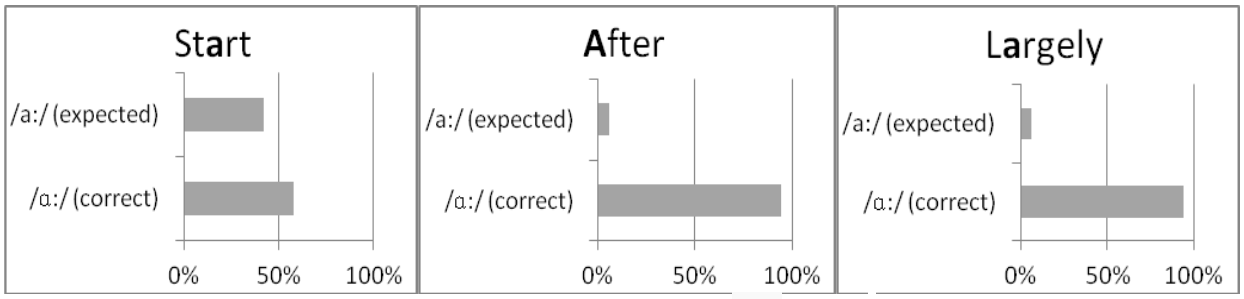


Figure 40, **Norwegian pilots: /ɑ:/ and /a:/**

The findings reveal that the perception of the RP /ɑ:/ is not the same in different words. For example, both Latvian and Norwegian respondents for some reason found it difficult to distinguish between the two tested sounds in the word *start*, but not in the words *after* and *largely*. Was it spelling that influenced their choice? Probably not, as the tested sound corresponds to the same letter and appears in the middle of the word *start* as well as in the middle of the word *largely*. The word *start* does not seem to be less familiar than the other two words. The COCA says that the word *start* is used 255 times per million words, the word *after* 1145 times per million words, and the word *largely* 53 times per million words. The BNC gives very similar frequencies: 236 instances per million words for the word *start*, 1157 for the word *after*, and 74 for the word *largely*. The American pronunciation of the tested sound is the same for the words *start* and *largely* (*Longman Dictionary of Contemporary English*, 2009). The word

st<u>a</u>rt is not the longest one out of the tested words. So far, I cannot resolve the puzzle as to why the pilots have more problems with the perception of a sound in some words, but not in others.

Overall results of the first part

I will start with a summary of the first part of the test and proceed with some overall observations.

The first tested sound was the RP sound /ɜ:/ vs. the /æ:/ (Latvian counterpart) and /ø:/ (Norwegian counterpart). Both groups of pilots faced difficulties perceiving the sound /ɜ:/: the Latvians managed to recognize this sound only 37% of the time, and the Norwegians only 33% of the time, and the difference between the Latvians and Norwegians is not statistically significant. The difference between the Latvians and Norwegians is extremely statistically significant as regards the choice of the counterpart sounds (p-value = less than 0.0001), as the Latvian and Norwegian pilots chose the Norwegian sound /ø:/ most often. The difference between the two groups with respect to choosing this sound is very statistically significant (p-value = 0.0019). Even though most of the Latvian participants decided on the unexpected phoneme, the Latvians chose the /æ:/ ten times more often than the Norwegians, and this difference is extremely statistically significant (p-value = 0.0006). This proves that they chose their expected sounds to different degrees, and the difference goes in the expected direction. The results were different for the three tested words. It might be that the choice of the pilots was affected by the spelling of these words, but it is unlikely that the words' frequency, length or the difference between British and American pronunciations have influenced the pilots' decisions.

The second tested sound was the RP sound /ʌ/ vs. /a/ (Latvian counterpart) and /ø/ (Norwegian counterpart). Both groups of participants had problems with the RP sound /ʌ/: the Latvians gave the right answer only 47% of the time, and the Norwegians 60 % of the time, and the difference between the two groups reaches statistical significance (p-value = 0.0397). The Latvians mixed the RP /ʌ/ with the /a/ two times more often than the Norwegians (the difference is extremely statistically significant, p-value = 0.0003), and confused it with the Norwegian /ø/ about half as often as the Norwegians (the difference does not reach statistical significance). The difference between the number of expected answers of the Latvians (in relation to all incorrect answers) and the number of expected answers of the Norwegians (in relation to all incorrect answers) is extremely statistically significant (p-value = 0.0002). The results for each word

differed. However, there is no evidence that it was spelling, frequency, length of the tested words or the pronunciation differences that might have had an impact on the results.

The pilots were then tested for the RP sound /ə/ (Norwegians were expected to choose it) vs. the /æ/ (Latvian counterpart) and /e/ (Latvian counterpart). The RP schwa caused pronounced difficulties for both Latvians and Norwegians: the Latvian pilots recognized the tested RP sound only 35% of the time, and the Norwegian pilots only 41% of the time. The difference between the correct answers of the two groups is not statistically significant. The most frequently chosen sound by both groups of pilots was the sound /æ/ (the difference between the two groups with respect to choosing this sound is not statistically significant). Therefore, the difference between the expected phonemes chosen by the Latvians and the expected phonemes chosen by the Norwegians is extremely statistically significant (p-value = 0.0003). The Latvians decided on the sound /e/ almost three times more often than the Norwegians (the difference is very statistically significant, p-value = 0.0068), but the respondents in both groups rarely chose this option. The pilots demonstrated different perception of the same sound in the three tested words. On the one hand, frequency, length and spelling might provide explanations as to why the participants made the highest number of mistakes in one particular word. On the other hand, the results for the two other tested words were also poor, and frequency, spelling and length cannot explain the difference between the other two words.

The next task of the participants was to recognize the RP diphthong /ɪə/ vs. /iə/ (Latvian counterpart) and /eə/ (Norwegian counterpart). The test takers showed poor results: the Latvian pilots distinguished the RP diphthong /ɪə/ from its Latvian and Norwegian counterparts only 31% of the time, and the Norwegian pilots only 30% of the time (the difference between the Latvians and Norwegians is not statistically significant). Most of the participants confused the RP /ɪə/ with the diphthong /eə/, though the Norwegians to a greater extent than the Latvians, and the difference between the Latvians and Norwegians when it comes to the choice of expected sounds is extremely statistically significant (p-value = less than 0.0001). The answers of the Latvians were almost evenly distributed between the three options, and the Latvians decided on the /iə/ almost four times more often than the Norwegians. I measured how likely the two groups were to choose the same sound. The results of the t-test show that the participants were more prone to choose their counterpart sounds, and the difference between the two groups is extremely statistically significant for both the Latvian /iə/ (p-value = less than 0.0001) and the Norwegian

/eə/ (p-value = 0.0003). I did not manage to find any reason why it was easier for the participants to recognize the tested diphthong in one word than in the others.

The pilots listened to words with the RP diphthong /eə/ vs. /æə/ (Latvian counterpart), /æːə/ (Norwegian counterpart) and /eːə/ (Norwegian counterpart). The majority of the participants did not have difficulties recognizing the right pronunciation: the Latvian pilots chose the RP /eə/ 64% of the time, and the Norwegian pilots 79% of the time, and the difference between the two groups is statistically significant (p-value = 0.0208). The Latvians decided on the /æə/ almost four times more often than the Norwegians (the difference reaches statistical significance, p-value = 0.0137), they chose the /eːə/ almost as often as the Norwegian participants (the difference is not statistically significant), and marked /æːə/ as the correct answer more often than the Norwegians (the difference is not statistically significant). The difference between the expected answers chosen by each group of pilots is not quite statistically significant either. When it comes to the three tested words, the results for each word do not differ that much.

The participants were asked to distinguish the RP diphthong /ʊə/ from /uo/ (Latvian counterpart) and /ʉ/ (Norwegian counterpart). Both groups found it problematic to recognize the right RP variant: the Latvian respondents gave the correct answer 27% of the time, and the Norwegian respondents 58% of the time, and the difference between the Latvians and Norwegians is extremely statistically significant (p-value = less than 0.0001). The Latvians preferred the Latvian diphthong two and a half times more often than the Norwegians (the difference is extremely statistically significant, p-value = less than 0.0001), and chose the Norwegian counterpart almost as often as did the Norwegian pilots (the difference is not statistically significant). The difference between the two groups for the chosen counterpart sounds is extremely statistically significant (0.0005). The incorrect responses of the Norwegian participants were almost evenly distributed between the Latvian /uo/ and Norwegian /ʉ/. The pilots perceived the same RP diphthong differently in the three tested words. So far, it is not clear what these differences depend on.

The next tested sound was the RP sound /ɒ/ vs. /ɔ/ (Latvian and Norwegian counterpart). The Latvian and Norwegian pilots recognized the RP sound /ɒ/ half of the time (52% and 49%; the difference is not statistically significant). The rest of the time they chose the /ɔ/ (the difference between the two groups for the expected /ɔ/ is not statistically significant). The findings illustrate that the pilots do not distinguish between the RP /ɒ/ and /ɔ/ of their mother

tongues. The Latvians and Norwegians had opposite results for each separate word. Therefore, it was hard to explain which factors influenced each group of participants and why.

The last tested sound of the first part of the test was the RP sound /ɑ:/ vs. /a:/ (Latvian and Norwegian counterpart). The findings show that the majority of the Latvian and Norwegian pilots do not have problems with the perception of the RP /ɑ:/: the Latvian respondents recognized the correct RP pronunciation 73% of the time, and the Norwegian respondents 82% of the time (the difference between the Latvians and Norwegians is not statistically significant). The rest of the time, the test takers gave preference to the sound /a:/ (in case of the /a:/, the difference between the two groups is not statistically significant). It was more difficult for both groups of pilots to perceive the tested sound in one of the three tested words. After comparing the spelling, frequency, length and the British and American pronunciations of the tested words, I came to the conclusion that these factors did not explain the participants' decisions.

As an overall observation, it is safe to say that both groups mixed most of the tested phonemes. The most difficult sounds for both groups were the sounds /ɜ:/, /ə/ and /ɪə/. The diphthong /ʊə/ turned out to be especially difficult for the Latvian participants. The phonemes /eə/ and /ɑ:/ created fewer problems for both groups of pilots.

As we see, very often the Latvian and Norwegian pilots had problems with the same sounds, and the charts look a bit similar in shape. This shows that there is something going on which seems to affect the Latvians and Norwegians in the same way.

When it comes to language transfer, there is a uniform pattern in most of the cases. However, the influence of the L1 is not obvious at first glance, i.e. we can observe language transfer not because the Latvians chose the Latvian counterpart most of the time, and the Norwegians gave preference to the Norwegian "equivalent" most of the time, but because the Latvians mixed the RP phonemes with the Latvian phonemes more often than the Norwegians, or the Norwegians confused the tested sounds with the native Norwegian sounds more often than the Latvians.

For example, the Latvian pilots chose the expected /æ:/ when listening to the RP /ɜ:/ only 20% of the time, but the Latvians chose this phoneme ten times more often than the Norwegians. As for the RP /ʌ/, although the test takers chose the Latvian counterpart /a/ most of the time, the Latvians decided on this variant two times more often than the Norwegians, and the Norwegians marked the Norwegian counterpart /ø/ more often than the Latvians. We see the same pattern with the RP diphthong /ɪə/. Even though the answers of the Latvian participants were distributed

almost evenly between the three possible options, whereas the Norwegians preferred the expected diphthong /eə/, the Latvians chose the Latvian counterpart more often than the Norwegians, and the Norwegians chose the Norwegian counterpart more often than the Latvians.

If we look at the RP /ʊə/, we see that most of the Latvian participants confused it with the Latvian diphthong /uo/, but the Norwegians mixed the tested sound with the Latvian /uo/ and Norwegian /ʉ/ almost to the same extent. Still, a larger percentage of the Norwegians who confused the tested sound decided on the Norwegian counterpart rather than on the Latvian diphthong. There is a similar situation with the diphthong /eə/. Certainly, the Latvian and Norwegian pilots chose the Norwegian counterparts more often, but a larger portion of the Latvians who made mistakes chose the Latvian counterpart.

The sounds /ɒ/ vs. /ɔ/ and the final pair /ɑ:/ vs. /a:/ were included in order to compare the cases where I expected L1-related differences and the cases where the Norwegians and Latvians were supposed to behave similarly. Having these last cases as a kind of control makes it clearer that the other differences are due to L1 differences, because the participants performed in a similar manner with the control sounds, as expected.

But were the RP sounds that differ more in position from their Latvian and Norwegian counterparts more difficult or easier to recognize than the ones close to Latvian and Norwegian sounds? There was no direct dependence between the distance of the tested RP sounds and their Latvian and Norwegian counterparts, and the perception of the RP sounds. For example, the participants found it more problematic to distinguish the diphthong /ɪə/ from the /iə/ and /eə/ than /ʌ/ from /a/, even though the counterpart phonemes differ more in position in the first case than in the second. This shows that the pilots did not tend to assimilate the closest sounds to their counterpart sounds more readily than those that differ more in position. However, it was easier for the pilots to distinguish between the RP /ɑ:/ and /a:/ than the RP /ʌ/ and /a/, and in this case the first sound pair differs more in position than the second one.

The /ə/ vs. /æ/ and /e/ does not fit the patterns when it comes to language transfer. In this case, the Latvians and Norwegians behaved in a similar way despite the prediction that the Norwegian participants might not have as many problems with the RP schwa as the Latvian participants, because they have a similar sound in their native language. One possible reason for the misfit might be that the more open pronunciation of final schwa for some English speakers could have influenced their choice of /æ/.

The results of this part of the test show that the frequency, spelling, length and the difference between British and American pronunciations of the tested words do not seem to be important factors which might influence sound perception. At least, there were many cases where these factors did not seem to explain the differences found.

As hypothesized, the Norwegian participants demonstrated better results than the Latvian participants, and in three out of eight tested cases (namely, for the sounds /ʌ/, /eə/ and /ʊə/) the difference between the number of correct answers given by the Norwegians and the number of correct answers given by the Latvians is statistically significant (in all of these cases the Norwegians got higher scores).

After calculating whether there was a statistical significance with respect to choosing the same sound, I got the following results: in all the tested items (in six out of six tested sound pairs, excluding the two sound pairs with control sounds where the expected/counterpart sounds were the same for both groups of pilots and we cannot compare the choice of the counterpart sounds for each group separately) the Latvians marked their counterpart sounds (expected sounds) more often than their Norwegian colleagues marked the Latvian counterpart sounds, and the differences reach statistical significance. As for the Norwegian group, in two out of six tested sound pairs the Norwegians chose their counterpart sounds significantly more often than the Latvians chose the Norwegian counterpart sounds. With the other four tested sound pairs, the difference was not statistically significant. If the Latvians chose Latvian sounds statistically more often than Norwegians did six times, and Norwegians chose Norwegian sounds more often than Latvians did only two times, that means that Latvians chose Norwegian sounds more often than Norwegians chose Latvian sounds. So it seems that Norwegians mainly make mistakes in the direction of their mother tongue, whereas Latvians make mistakes in both directions more often. Thus it is difficult to say who is more influenced by their mother tongue.

I measured also the difference between the number of expected answers of the Latvians (in relation to all incorrect answers) and the number of expected answers of the Norwegians (in relation to all incorrect answers). The results show that with two tested sound pairs the Norwegians chose Norwegian counterpart sounds more often than the Latvians chose Latvian counterpart sounds, and with three tested sound pairs the Latvians marked Latvian counterpart sounds more often than their Norwegian colleagues marked Norwegian counterpart sounds. With the other three tested sound pairs the difference was not statistically significant. (Here I included the items with the control sounds because we can compare expected sounds by each group in

relation to all incorrect answers.) Again, the two tested groups demonstrated similar results, and it is difficult to say whether one of the groups was more influenced by their mother tongue than the other.

All in all, there are signs of L1 influence, but there are also common influences, even though it is difficult to say what these are without doing further research. It is also not clear why the pilots perceived the same tested phoneme better in some words than in others. We cannot say that it was due to chance, because often the same word was the most difficult for both groups. Still, I do not yet have any reasonable explanation for this. The Latvian group faced more difficulties with the perception of the RP phonemes than the Norwegian group. Both groups of participants were influenced by their L1s, and it is difficult to say who was influenced by their native language to a greater extent.

8.2 Part 2 & part 3

In the first part of the test, I tried to find out whether Latvian and Norwegian pilots would be influenced by the sounds of their mother tongues and mark these sounds as the correct answers instead of the right RP variants. It was interesting to see whether there is language transfer and to what extent the pilots prefer their native sounds. In the second and third parts of the test, I attempted to check whether there are language-specific perception problems as regards the existing English phonemes, namely whether L1 influence affects not only the perception of specific nuances of sounds, but also the ability to distinguish between English phonemes which could cause misunderstandings in real life. According to my hypothesis, connected speech might create additional problems, especially out of context or in ambiguous contexts. In the second and third parts I tested how Latvian and Norwegian pilots distinguish between the same English phonemes in connected speech and in isolated words. In this section, I will discuss whether there are differences between the two groups of pilots, and how the perception of the same sounds differs in connected speech and in isolated words.

In the second part of the test, the pilots listened to sentences (connected speech). One of the words in each sentence was missing. Above each sentence, there were two possible words (different only with respect to the targeted vowel phonemes) with a translation into the pilots' mother tongues. The sentences were designed in such a way that it was impossible to guess the right word from the context. The participants were asked to mark the word which they hear in the

recording. For example, "One of the passengers found a *pen/pin* on the floor", or "He gave me a *pet/pat*".

The task of the participants in the third part of the test was almost the same. The only difference was that there were two isolated words to choose from, instead of two missing words in sentences, e.g. *bit/bet* or *luck/lack*. (See Latvian and Norwegian variants of the test in appendix 6.)

After presenting the results for each sound pair I checked whether the differences I found were statistically significant. As regards sound pairs in parts 2 and 3 of the test, I counted whether the differences between the Latvian and Norwegian groups were statistically significant by comparing the correct answers of the Latvian and Norwegian participants for every sound pair for the second and third parts of the test together. That is, I added the correct answers of the second part to the correct answers of the third part for the Latvians for every sound pair and did the same with the Norwegians, and then compared the correct answers of the Latvians with the correct answers of the Norwegians for every sound pair using a t-test (see detailed information about the t-test at the beginning of chapter 8.)

Also, I checked whether the difference between connected speech and isolated words for every sound pair was statistically significant for the Latvians and then for the Norwegians. I compared the correct answers of the second part (connected speech) of the Latvian group with the correct answers of the third part (isolated words) of the Latvian group for every sound pair using a t-test, and then I did the same with the Norwegians. As for connected speech vs. isolated words, in some cases there were two possible correct answers for connected speech and only one possible correct answer for isolated words in the test. In order to compare the results, I equated the results of the second part with the results of the third part by counting 2 correct answers of the second part as 1 correct answer, and 1 correct answer of the second part as 0.5 of a correct answer.

RP /ɪ/ vs. RP /e/

In the second part, the perception of the RP sound /ɪ/ vs. the RP sound /e/ was tested in sentences 1, 10 and 19. The sound /ɪ/ was used in the word *pin*, and the pilots could choose between the words *pin* and *pen*. The sound /e/ was used in the words *better* and *letter*, and in these cases the pilots also had the choice of the words *bitter* and *litter*. This sound pair was expected to be difficult for both groups of pilots. The /ɪ/ is more likely to be heard as the /e/ than opposite, as the RP /ɪ/ is more open than the Latvian and Norwegian /i/ and therefore closer to their /e/.

The participants did not have many problems with this sound pair. Both groups of pilots found it easier to choose the right word when /e/ was used (the Latvians 95% of the time and the Norwegians 99% of the time) than when /ɪ/ was used (the Latvians 83% of the time and the Norwegians 92% of the time). (For detailed information, see appendix 9.)

The results of the second part partly agree with the hypothesis. It was predicted that this pair of monophthongs would be difficult for both groups of pilots; however, the participants did not have great problems with these sounds. It was also predicted that /ɪ/ would be more likely to be heard as /e/ than opposite. This turned out to be the case, and the reason might be the influence of their L1s, as hypothesized.

If we look at the separate words, we will see that the Latvian test takers did not have any mistakes when distinguishing *letter* from *litter*, but mistook *better* for *bitter* 10% of the time. The Norwegian respondents demonstrated the opposite results. They did not have any mistakes when it came to *better* vs. *bitter*, but they mistook *letter* for *litter* 2% of the time.

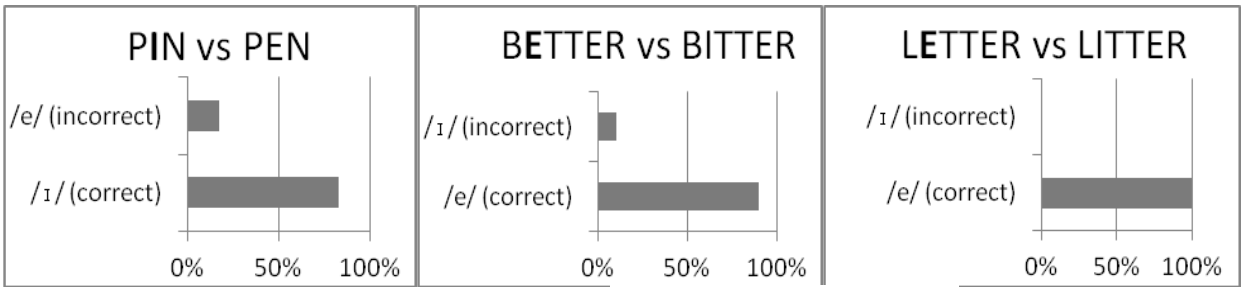


***Figure 41*, Latvian pilots: /ɪ/ vs. /e/ (connected speech)**

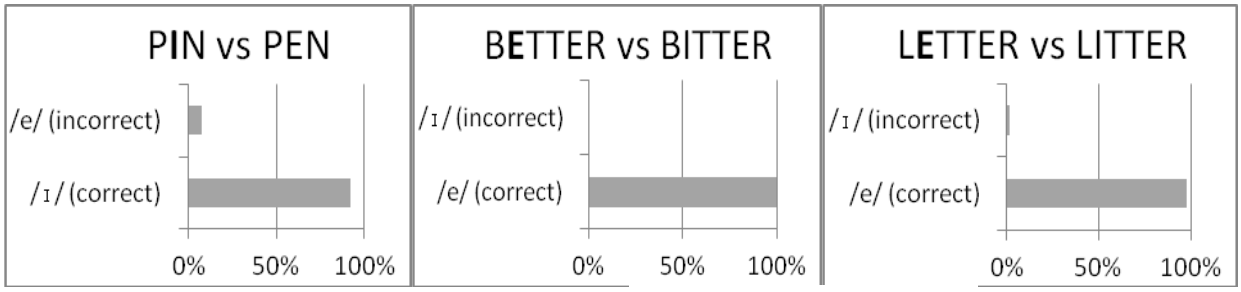


***Figure 42*, Norwegian pilots: /ɪ/ vs. /e/ (connected speech)**

The Latvian and Norwegian respondents made mistakes in different words (the Latvians in *better*, but the Norwegians in *letter*). I do not think that it is worth paying much attention to this difference in this particular case, as the numbers are very small, and it could have happened due to chance, but not because these two words belong to different word categories or for any other reason.

In the third part, the pilots were tested for the same sounds in the isolated words *sit* (vs. *set*) and *bet* (vs. *bit*) in items 1 and 10. The Latvian pilots managed to recognize the RP /ɪ/ 97% of the time, and the Norwegian pilots 100% of the time. The Latvian pilots managed to recognize the /e/ 100% of the time, and the Norwegian pilots 98% of the time. (For detailed information, see appendix 10.)

There were just two tested words for each sound pair in the third part of the test (the reason was the economy of time), i.e. one tested word per one tested sound. That is why there is no possibility to compare different words with the same sound in this part of the test.

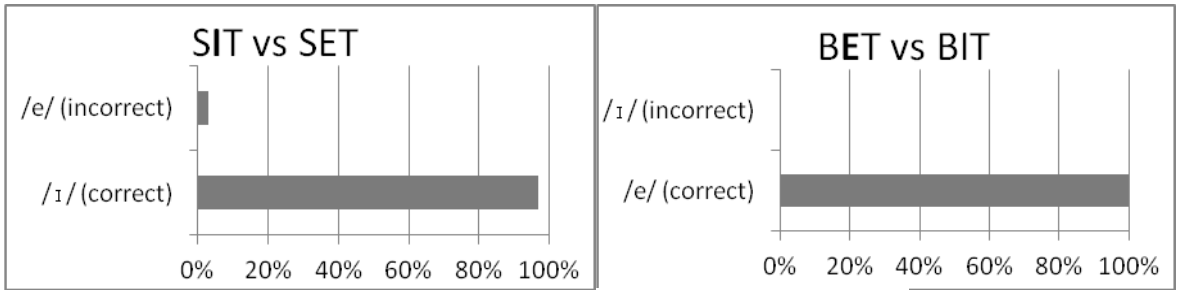


Figure 43, **Latvian pilots: /ɪ/ vs. /e/ (isolated words)**

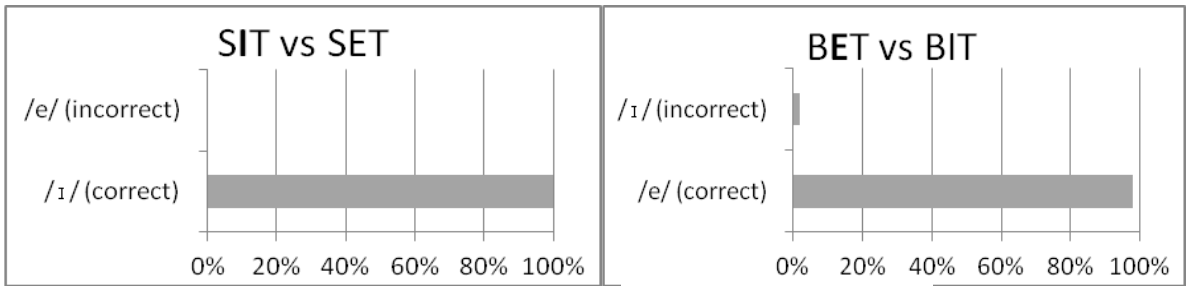


Figure 44, **Norwegian pilots: /ɪ/ vs. /e/ (isolated words)**

The participants' answers for the second and third parts of the test give us the following picture: the Latvian and Norwegian pilots do not have many problems distinguishing between the RP sounds /ɪ/ and /e/, which contradicts the hypothesis. The difference between the Latvians and Norwegians here does not reach statistical significance for the words with /ɪ/ (p-value = 0.1629) and /e/ (p-value = 0.2926).

In accordance with the hypothesis, it was more problematic for the respondents to distinguish between the tested sounds in connected speech than while listening to isolated words. The difference is small, though. The pilots made very few mistakes with the /ɪ/ and /e/, especially the Norwegians. In this case there might be a so-called ceiling effect. That means that if the distinction was so easy for them that they did not make mistakes, we cannot conclude anything

about whether connected speech was more difficult than isolated words. Still, the results of the t-test show that the difference between connected speech and isolated words is statistically significant for the Norwegian group distinguishing the /ɪ/ from the /e/ (p-value = 0.0415), but not in the other cases (/e/ vs. /ɪ/ NO, p-value = 1.0000; /ɪ/ vs. /e/ LV, p-value = 0.0796; /e/ vs. /ɪ/ LV, p-value = 0.0727).

The results from the second part of the test confirm the hypothesis which predicted that the /ɪ/ would be more likely to be heard as /e/ than vice versa. However, in the third part of the test, the Norwegian participants made a few mistakes when distinguishing the /e/ from the /ɪ/, but not the opposite way. For this reason, we cannot conclude that the findings completely support the hypothesis, and that it is easier for the Latvian and Norwegian pilots to categorize RP /e/ correctly than RP /ɪ/. Also, I cannot draw firm conclusions from small differences, as they might be due to chance. According to the statistical analysis, connected speech created more difficulties only for the Norwegian pilots when recognizing the /ɪ/.

RP /ʌ/ vs. RP /æ/

The perception of the RP sounds /ʌ/ and /æ/ was tested in the word pairs *c<u>u</u>p* (vs. *c<u>a</u>p*), *tr<u>u</u>ck* (vs. *tr<u>a</u>ck*) and *b<u>ag</u>* (vs. *b<u>ug</u>*) in sentences 3, 12 and 21. It is more likely that the Latvians and Norwegians would mix the RP /ʌ/ with the /æ/ than with the /ɒ/ (which is discussed next).

The RP /ʌ/ is close to the Latvian and Norwegian /a/. While the Latvians might mix it with the /a/, the Norwegians are expected to mix it with the Norwegian /ø/ (Vanvik, 1975: 16). In the first part, I tested whether the pilots would mix the /ʌ/ with the /a/ and /ø/. In the second and third parts, I included the control sounds /æ/ and /ɒ/ to compare whether the pilots would mix the RP /ʌ/ more with the expected sounds /a/ and /ø/ than with the /æ/ and /ɒ/. I would not expect them to mix the /ʌ/ with the /æ/ or /ɒ/. However, if they still do, it is more likely that they mix the /ʌ/ with the /æ/ because it is unrounded like the /ʌ/. The Norwegians are expected to have fewer problems recognizing /æ/ than /ʌ/, as the Norwegian /æ/ is very close to the RP /æ/.

Neither group of pilots found it difficult to recognize /æ/. The Norwegian respondents did not have any mistakes at all. The Latvian respondents provided the correct answers 86% of the time. It was not problematic for the Norwegians to distinguish the /ʌ/ from the /æ/ (96% correct responses), but the Latvians decided on the right option /ʌ/ only 60% of the time. (For detailed information, see appendix 9.)

The Latvian pilots were expected to face more difficulties distinguishing the RP sounds in general than the Norwegians, and the results for this sound pair support this hypothesis. For

the test takers it was easier to distinguish the /æ/ from the /ʌ/ than the opposite way. As regards the Norwegians, this might have happened due to the fact that the Norwegians gave preference to the most familiar sound. The position of the /æ/ is one of the major differences between Latvian and Norwegian. The Norwegian phoneme is similar to the RP /æ/, but the Latvian /æ/ is closer and more central (see figure 12 in chapter 4). While the positions of the /æ/ sounds might be an explanation why the Norwegians had fewer problems recognizing the words with /æ/ than the words with /ʌ/, it does not explain the choice of the Latvians.

The sound /ʌ/ was used twice in two different words. Both groups of test takers demonstrated worse results with the word *tr<u>u</u>ck* (vs. *tr<u>a</u>ck*) (52% correct responses for the Latvians, 90% correct responses for the Norwegians) than with the word *c<u>u</u>p* (vs. *c<u>a</u>p*) (69% correct responses for the Latvians, 98% correct responses for the Norwegians).

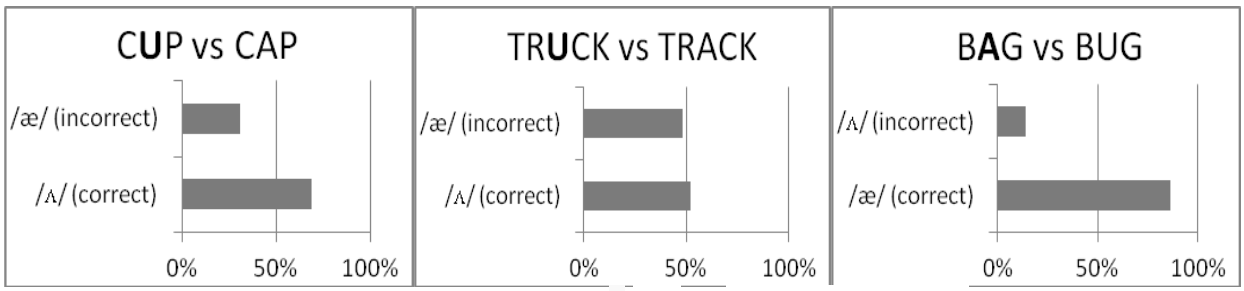


Figure 45, **Latvian pilots: /ʌ/ vs. /æ/ (connected speech)**

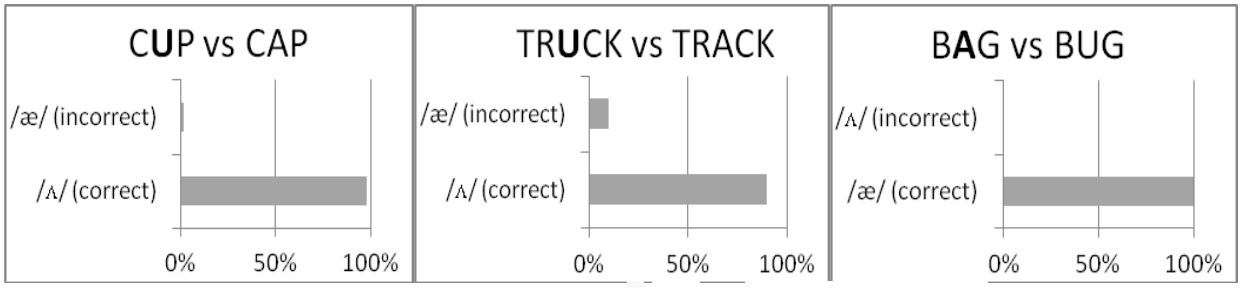


Figure 46, **Norwegian pilots: /ʌ/ vs. /æ/ (connected speech)**

Both Latvians and Norwegians found it more complicated to distinguish the word *tr<u>u</u>ck* from the word *tr<u>a</u>ck* than the word *c<u>u</u>p* from the word *c<u>a</u>p*. We cannot say that the word *tr<u>u</u>ck* is longer than the word *c<u>u</u>p*, as both words are of one syllable. The tested sounds stand for the same letters in both words, that is why it is unlikely that there is something to do with the spelling differences. It is also unlikely that British/American pronunciation differences could influence the pilots' choice, as the pronunciation of these words do not differ as regards geographical variety (*Longman Dictionary of Contemporary English*, 2009). Maybe the participants were

more familiar with the words *cup* and *cap* than with the words *truck* and *track*. For instance, they might have used the British word *lorry* more often than *truck*. Taking a look at the corpora, we see that the word *truck* is used less often than the word *cup* indeed. In the COCA, the word *cup* appears 176 times per million words, while the word *truck* only 51 times. The BNC says that the frequency of the word *cup* is 121 instances, and that of the word *truck* only 11 instances per million words.

Now let us look at how the results for this group of sounds in connected speech differ from the results for the same group of sounds in isolated words. The RP sounds /ʌ/ and /æ/ were tested in items 3 and 12 in the isolated words *luck* (vs. *lack*) and *lag* (vs. *lug*). Both Latvian and Norwegian test takers demonstrated approximately the same results when distinguishing the sounds in isolated words and in connected speech. The Latvian pilots distinguished the /ʌ/ from the /æ/ 77% of the time, and as often they distinguished these sounds the other way around. Interestingly, the situation with the Norwegian pilots was the same. The Norwegian participants had the right answers for the words with /ʌ/ 96% of the time, and as often they had the right answers for the words with /æ/. (For detailed information, see appendix 10.)

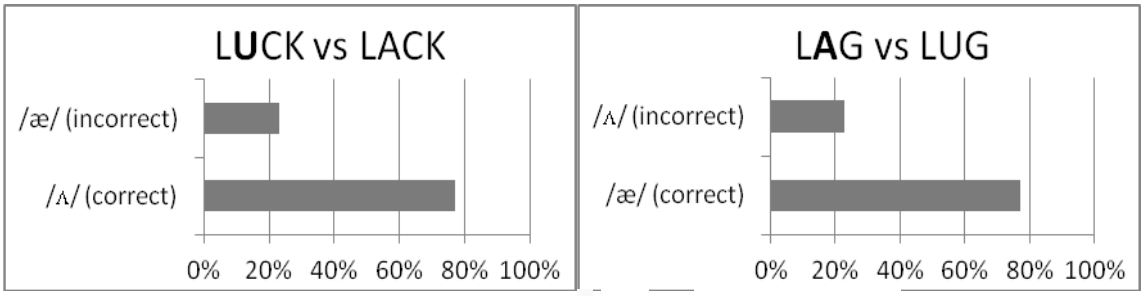


Figure 47, **Latvian pilots: /ʌ/ vs. /æ/ (isolated words)**

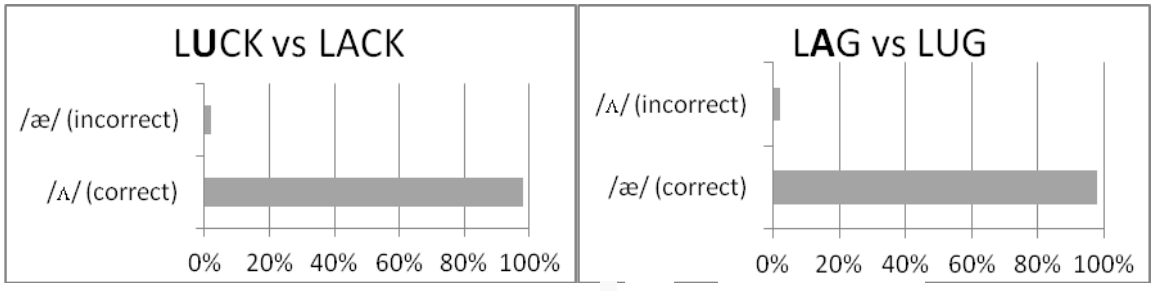


Figure 48, **Norwegian pilots: /ʌ/ vs. /æ/ (isolated words)**

The statistical analysis indicates that the difference between the Latvian and Norwegian groups was extremely statistically significant as regards the words with /ʌ/ (p-value = less than 0.0001) and the words with /æ/ (p-value = 0.0003).

It was hypothesized that listeners might confuse the foreign language sounds more in connected speech because the native speakers tend to pronounce words with different speed, rhythm, to employ various unfamiliar reduction patterns, etc. The findings for this group of the RP sounds do not support the hypothesis. The Latvians and Norwegians showed approximately the same results for isolated words, and the difference between connected speech and isolated words does not reach statistical significance for any group of pilots (/ʌ/ vs. /æ/ LV, p-value = 0.1412; /æ/ vs. /ʌ/ LV, p-value = 0.3555; /ʌ/ vs. /æ/ NO, p-value = 0.2392; /æ/ vs. /ʌ/ NO, p-value = 0.3199).

The percentages of correct answers for this sound group are quite high. Especially for the Norwegian respondents, who made only a few mistakes. The Latvian participants found it more difficult to recognize both sounds, but especially the /ʌ/. The statistical results show that the Latvian pilots demonstrated worse performance than their Norwegian colleagues with both /ʌ/ and /æ/, and the difference between the Latvians and Norwegians is extremely statistically significant.

It was also predicted that Latvians and Norwegians would choose the words with /ɒ/ when the target had /ʌ/, though to a lesser extent than the words with /æ/ when the target had /ʌ/, as the /æ/ is unrounded as well as the /ʌ/. We can check whether it is so by proceeding with the next group of sounds, the /ʌ/ vs. the /ɒ/.

RP /ʌ/ vs. RP /ɒ/

Sentences 4, 13 and 22 were made up to test whether the pilots mix the /ʌ/ and /ɒ/. The task of the participants was to recognize the word *nut* (vs. *knot*), and the words *lock* (vs. *luck*) and *dock* (vs. *duck*). It is unlikely that the pilots would mix the /ʌ/ with the /ɒ/. However, the Norwegian short /ɔ/ is closer to the RP /ɒ/ than the Latvian /ɔ/. Therefore, the Latvians might perceive the /ɒ/ as the /ʌ/ more readily than the Norwegians.

Both Latvian and Norwegian test takers found it hard to distinguish the /ʌ/ from the /ɒ/: the Latvians managed to do it only 62% of the time, and the Norwegians only 52% of the time. The participants demonstrated better results with the opposite direction: the Latvian participants distinguished the /ɒ/ from the /ʌ/ 81% of the time, and the Norwegian participants 94% of the time. (For detailed information, see appendix 9.)

It looks like both groups are more ready to think that the /ʌ/ is the /ɒ/ than opposite. Both groups have quite similar results for the perception of the /ʌ/, whereas the Norwegians seem better with the /ɒ/.

For some reason both Latvian and Norwegian pilots found it easier to recognize the sound /ɒ/ in the word *dock* (vs. *duck*) than in the word *lock* (vs. *luck*). The Latvian respondents gave the right answer for the word *dock* 90% of the time, and the Norwegian respondents 100% of the time. The Latvian respondents recognized the word *lock* only 72% of the time, and the Norwegian respondents only 88% of the time.

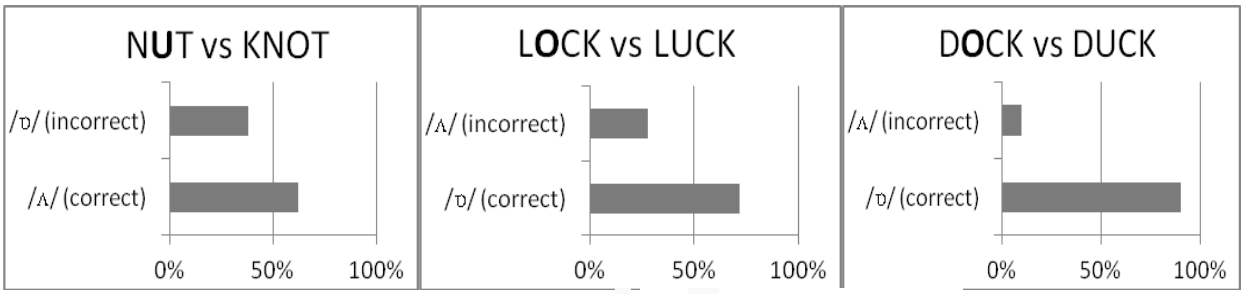


Figure 49, **Latvian pilots: /ʌ/ vs. /ɒ/ (connected speech)**

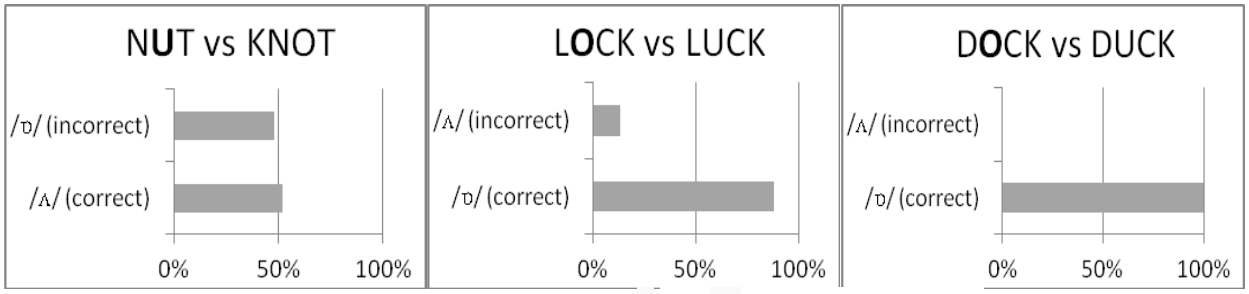


Figure 50, **Norwegian pilots: /ʌ/ vs. /ɒ/ (connected speech)**

It is hard to explain why both groups of pilots found it easier to recognize the word *dock* than the word *lock*. The spelling of these two words differs only with the first consonant, but the spelling of the vowels which stand for the tested sound is identical. These two words are also of the same length. According to the corpora, the word *lock* is used more often than the word *dock*: there are 21 instances per million words of the word *lock* in the COCA, and 25 in the BNC, and 13 for the word *dock* in both corpora. The British and American pronunciations of these two words coincide: the British variants are pronounced with the sound /ɒ/, but the American with the sound /ɑ:/ for both words (*Longman Dictionary of Contemporary English*, 2009). It is thus unlikely that it was the spelling, length, frequency or variety differences that influenced the pilots' decisions.

In the third part of the test, the participants heard the words *dull* (vs. *doll*) and *fond* (vs. *fund*) in isolation in items 4 and 13. Surprisingly, the Latvian pilots showed worse results for the same sounds in isolated words than in connected speech. The Latvian pilots managed to distinguish the /ʌ/ from the /ɒ/ 50% of the time, and to recognize the /ɒ/ 67% of the time. The

results of the Norwegian participants remained the same when recognizing the /ʌ/ (the Norwegians answered correctly 52% of the time), and improved very slightly as regards the /ɒ/ (the Norwegians provided the right responses 96% of the time). (For detailed information, see appendix 10.)

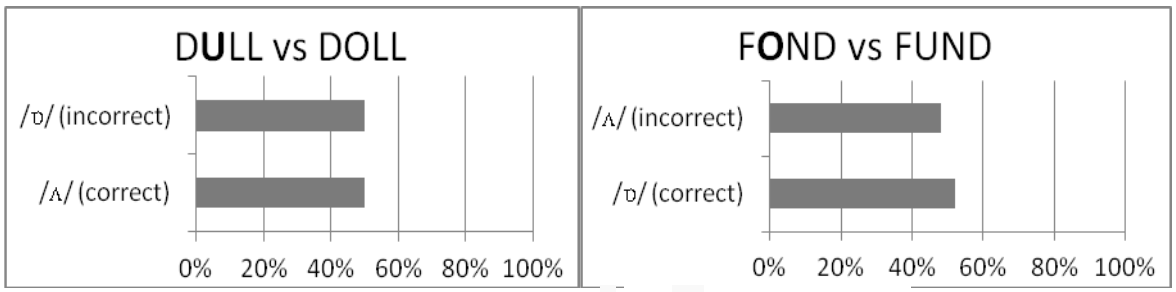


***Figure 51*, Latvian pilots: /ʌ/ vs. /ɒ/ (isolated words)**

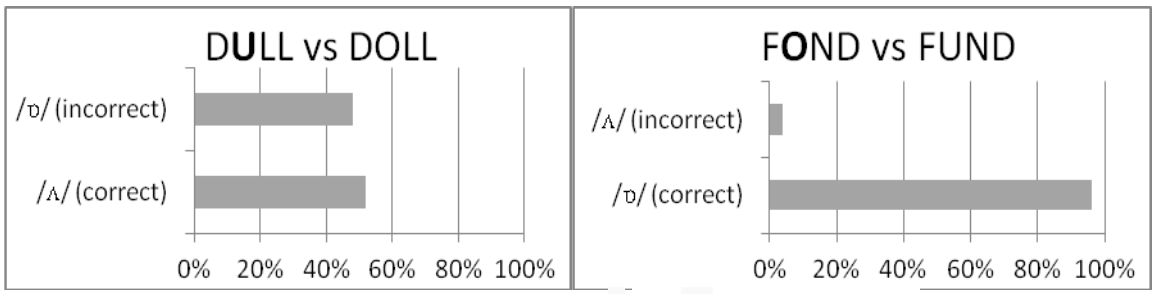


***Figure 52*, Norwegian pilots: /ʌ/ vs. /ɒ/ (isolated words)**

Speaking about the direction differences, here we see approximately the same pattern as with the previous word pairs. For both groups it was more difficult to distinguish the /ʌ/ from the /ɒ/ than the other way round, but it was easier for the Norwegians than for the Latvians to recognize the /ɒ/.

The results of the t-test show that the difference between the Latvian and Norwegian pilots was extremely statistically significant when recognizing the /ɒ/ (p-value = 0.0002), but not the /ʌ/ (p-value = 0.8793). This finding corresponds to the hypothesis which predicted that the Latvians might perceive the /ɒ/ as the /ʌ/ more readily than the Norwegians, because it is explainable on the basis of differences in their L1s.

On the one hand, it was unpredictable that there were more Latvians and the same number of the Norwegians who made mistakes in isolated words in comparison to connected speech. The words tested in isolation were not very frequent, but neither were the words of the second part of the test. In the COCA, the word *dull* is encountered only 12 times per million words, but the word *fond* 7 times. In the BNC, these words occur more frequently: the word *dull*

appears 18 times, and the word *fond* 11 times per million words. However, if we compare the frequency of the words of the second and third parts of the test, we will see that it is approximately the same. That is why the familiarity with the word is not a good explanation for why the pilots had more problems with the isolated words in comparison to the words in the sentences. But the difference between the pilots' performance in connected speech and isolated words is not great, and not statistically significant (/ʌ/ vs. /ɒ/ LV, p-value = 0.3592; /ɒ/ vs. /ʌ/ LV, p-value = 0.1790; /ʌ/ vs. /ɒ/ NO, p-value = 1.0000; /ɒ/ vs. /ʌ/ NO, p-value = 0.5832).

Who performed better with this group of sounds, the Latvian or the Norwegian respondents? Undoubtedly, the Norwegians demonstrated better results for isolated words. As for connected speech, it is hard to say for sure. The total percentages show that the Norwegians performed better. But the Latvians, in comparison to the Norwegians, do not have such a big drop from the correct responses for one direction to the incorrect responses for the other.

It was hypothesized that the participants might be more likely to mix the RP /ʌ/ with the /æ/ than with the /ɒ/, because the /ʌ/ and /æ/ are unrounded sounds, but the /ɒ/ is not. The findings of this study do not support this hypothesis. The number of the correct responses of the Latvian pilots in connected speech is almost the same for both sound pairs. Concerning the Norwegian participants' performance in the second part (testing the sounds in connected speech) and the Latvian and Norwegian participants' performance in the third part (testing the sounds in isolated words), the results are better for the /ʌ/ vs. the /æ/ than the /ʌ/ vs. the /ɒ/ sound pairs. The Norwegian and RP /æ/ sounds are very similar, whereas the RP /ɒ/ and the Norwegian /ɔ/ are more different. The Latvian and RP /æ/, and the Latvian /ɔ/ and the RP /ɒ/ are both some distance from each other. But perhaps the distance is shorter for the /æ/ sounds. This might have been the reason why the Latvian and Norwegian pilots demonstrated better results with the /ʌ/ vs. the /æ/ than the /ʌ/ vs. the /ɒ/ sound pairs, especially for the Norwegians.

It is curious that the Norwegians and Latvians have such problems with perceiving the /ʌ/ when both groups have a very similar /a/ sound. It could have something to do with spelling. The RP /ʌ/ is usually spelled with the letter *u*. The spelling *u* usually stands for the sound /u/ in Latvian, and for the sound /ʉ/ in Norwegian. But there certainly could be many other factors which influence the pilots' sound perception.

RP /ə/ vs. RP /ɪ/

In order to test the perception of the RP sounds /ə/ and /ɪ/, the pilots were asked to listen to the words *omission* (vs. *emission*), *allusion* (vs. *illusion*) and *edition* (vs. *addition*) in sentences 5, 14

and 23. Both groups were expected to have problems with the /ɪ/, as the RP /ɪ/ is more central and open than its Latvian and Norwegian counterparts. The Latvians might have more problems with the /ə/ than with the /ɪ/, as the schwa is not present in Latvian at all. They were also supposed to have more problems with the /ə/ than the Norwegians. The Norwegians have a sound which is close to the RP schwa.

This task was not easy for either group. The Latvian and Norwegian pilots faced enormous difficulties distinguishing the sound /ə/ from the /ɪ/, but the Latvians to a greater extent. The Latvians managed to do it only 22% of the time, and the Norwegians only 40% of the time. While processing the results, I noticed that some of the few Latvians and some of the few Norwegians who decided on the right option were hesitating. First, they gave the wrong answer and then corrected it to the right one. If we look at the results for the opposite direction, the picture changes dramatically. The participants did not have particular problems distinguishing the RP /ɪ/ from the RP /ə/: the Latvians were correct 86% of the time, and the Norwegians 98% of the time. (For detailed information, see appendix 9.)

The hypothesis that the schwa might create more difficulties for the Latvian pilots than for the Norwegians, and that Latvians might find it more problematic to distinguish the /ə/ from the /ɪ/ than vice versa, was proved correct. However, it seems that there could be a considerable difference between the RP schwa and the unstressed Norwegian /e/, because most of the Norwegian respondents did not demonstrate any familiarity with the tested sound.

Otherwise, the results for this sound pair differ from the initial predictions. It was believed that both groups of participants would have more problems recognizing the RP sound /ɪ/. In practice we see that there was only one Norwegian pilot out of 48 who chose the word with /ə/ when the target had /ɪ/, and four Latvian pilots out of 30 who chose the word with /ə/ when the target had /ɪ/.

It is interesting to find out whether the pilots made the same number of mistakes for the problematic schwa for both tested words or not. The Latvian respondents demonstrated very similar results for the word *omission* (vs. *emission*) and the word *allusion* (vs. *illusion*): they provided the right answer for the first word pair 24% of the time, and for the second word pair 21% of the time. The situation with the Norwegian participants was a little bit different. There were 29% who did not mix the words *omission* and *emission*, and 50% who recognized the word *allusion* (vs. *illusion*).

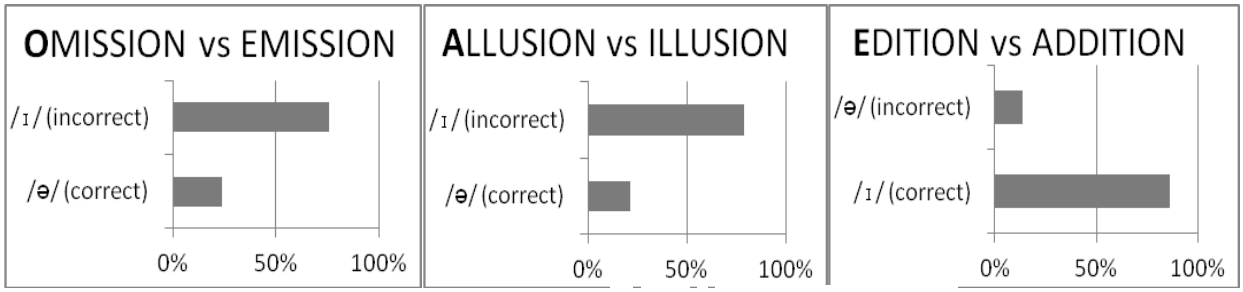


***Figure 53*, Latvian pilots: /ə/ vs. /ɪ/ (connected speech)**

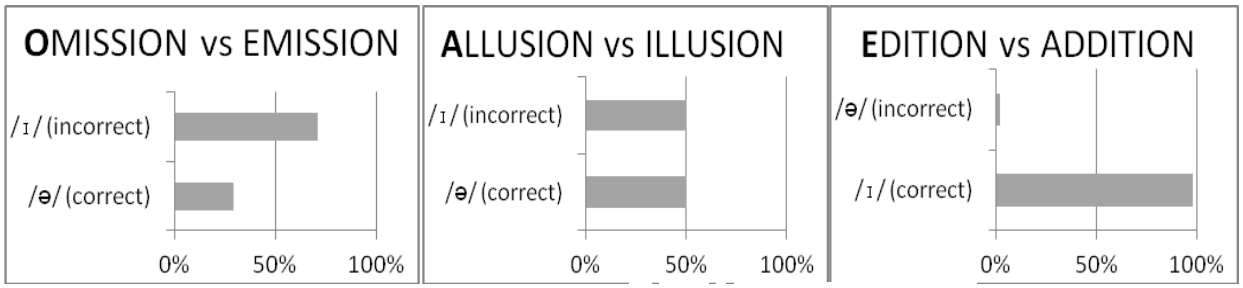


***Figure 54*, Norwegian pilots: /ə/ vs. /ɪ/ (connected speech)**

The findings show that the Latvian pilots found it equally difficult to recognize the right sound in the word *omission* (vs. *emission*) and in the word *allusion* (vs. *illusion*). It might be that the participants did not know the right pronunciation of either tested word, that is why they decided on the wrong option. Maybe they were misled by the spelling. The Norwegian participants performed better with the words *allusion* vs. *illusion*, than the second word pair. While the length of the words *omission* and *allusion* is the same, the spelling is not. For example, they might think that *emission* should be pronounced with the /ə/ and *omission* perhaps with the /ɒ/. In that case they would be likely to choose *emission* as their answer for the first word pair. It might be that the Norwegian participants associate the letter *a* with the schwa more than the *o*.

When it comes to the differences between British and American pronunciations, the word *allusion* is pronounced with the schwa in both varieties (*Longman Dictionary of Contemporary English*, 2009). In the American pronunciation of the word *omission* the RP schwa is substituted by the diphthong /oʊ/ (*ibid.*). It is possible that the Norwegian pilots were more used to the American variant, and that that is why it was more complicated for them to associate the heard pronunciation with the right tested word.

Neither of these words are particularly frequent. The COCA shows that the word *omission* is used 3 times per million words, and the word *allusion* only 1 time. In the BNC, there are 6 instances per million words for the word *omission*, and 1.5 for the word *allusion*. It might be that some of the participants were not very familiar with these words. This could have had a

negative influence on the results. Now let us turn to the third part of the test, which had more frequently used words, and see how the pilots recognized the same sounds in these words uttered in isolation.

The RP /ə/ and /ɪ/ were tested in the isolated words *accept* (vs. *except*) and *effect* (vs. *affect*) in items 5 and 14 of the third test. Altogether 53% of the Latvian and 58% of the Norwegian respondents recognized the word with the schwa, and 87% of the Latvian and 98% of the Norwegian respondents chose the correct word with RP /ɪ/. (For detailed information, see appendix 10.)

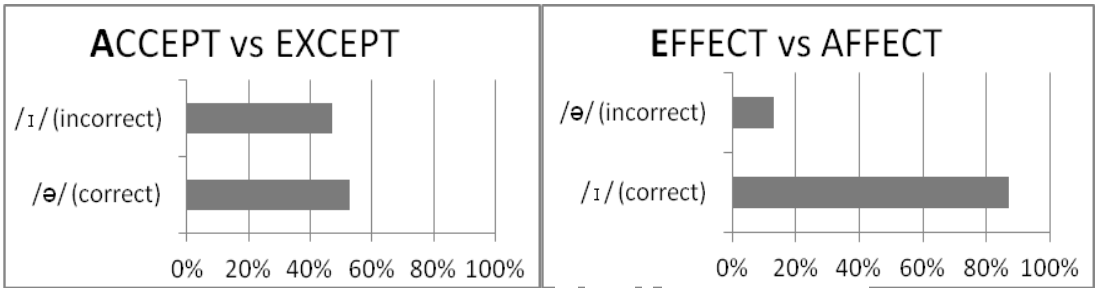


Figure 55, **Latvian pilots: /ə/ vs. /ɪ/ (isolated words)**

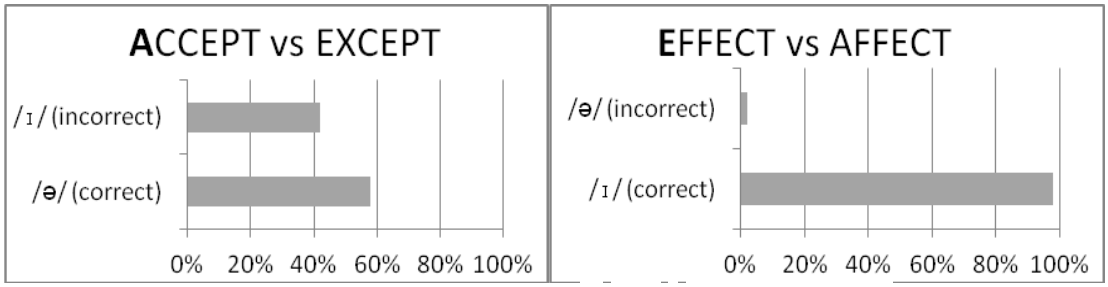


Figure 56, **Norwegian pilots: /ə/ vs. /ɪ/ (isolated words)**

The results of the t-test demonstrate that the difference between the Latvians and Norwegians is very statistically significant for the words with /ɪ/ (p-value = 0.0027) and statistically significant for the words with /ə/ (p-value = 0.0441).

Both groups of pilots acted the same when they had to distinguish the /ɪ/ from the /ə/ in connected sentences and in isolated words. There were no statistically significant differences (LV, p-value = 0.9598; NO, p-value = 1.0000). The results of the Norwegian pilots improved with 1/3 and the results of the Latvian pilots were more than two times better when they had the task of recognizing isolated words with /ə/ in comparison to words in connected speech. According to the t-test, this difference is statistically significant for the Norwegian participants, and very statistically significant for the Latvian participants (LV, p-value = 0.0058; NO, p-value

= 0.0366). As the results for the words with /ɪ/ were quite good even in connected speech, it is not unnatural that an improvement in results could only be detected for the more difficult sound. Again, from the spelling, it would seem more likely that both *accept* and *except* be pronounced with the /ə/, but unlikely that *affect* be pronounced with the /ɪ/. That might explain why there could be more mistakes of choosing *except* when *accept* was read than choosing *affect* when *effect* was read.

On the one hand, the results for this sound pair may indicate that it was easier for the participants to perceive the sounds in isolated words than in connected speech. On the other hand, the words in isolation were more frequent. That might also have had an impact on the choice of the respondents. Furthermore, if the results are indeed caused by the pilots not knowing the pronunciation of these words, or guessing on the basis of spelling, it does not really make sense to compare parts 2 and 3 and say whether connected speech was more difficult.

As regards the tested sound pair, the present study illustrates that both Latvian and Norwegian pilots have enormous difficulties with the perception of the RP /ə/, but especially the Latvian pilots. The difficulty for the Latvian and Norwegian participants may lie in the fact that the schwa is not found in the Latvian language, and is not the same in Norwegian (for more information about the Norwegian schwa, see chapter 4.2.1). We see some influence of the participants' L1s. However, not knowing the pronunciation of the words and being influenced by spelling are also the factors which, probably, influenced the pilots' perception of the RP sounds.

RP /e/ vs. RP /æ/

Sentences 2, 11 and 20 contained the words *tech* (vs. *tack*), *pat* (vs. *pet*) and *axe* (vs. *ex*) in which the sound /e/ vs. the sound /æ/ were tested. Both of these sounds exist in Latvian and Norwegian, but they represent one of the major differences between these two languages (see figure 12 in chapter 4). The Norwegian pilots are not expected to have difficulties with the perception of the sound /æ/, as the Norwegian and RP /æ/ sounds are very similar. The Latvian participants might have problems with the perception of the RP /æ/, as the Latvian /æ/ is closer and less front than the Norwegian and RP sounds. When it comes to the RP /e/, both groups of participants might face difficulties with this vowel phoneme. The Norwegian /e/ is more open and back, but the Latvian /e/ is closer and more front than the RP /e/ (see figure 12 in chapter 4).

According to the results, the Latvian respondents correctly chose the word with the sound /e/ 45 % of the time, and the Norwegian respondents 92% of the time. The Latvian participants

recognized the word with the sound /æ/ 76% of the time, and the Norwegian participants 96% of the time. (For detailed information, see appendix 9.)

The results of the pilots are close to the expectations. The Latvian participants distinguished the sound /e/ from the sound /æ/ less than a half of the time, and the sound /æ/ from the sound /e/ 3/4 of the time. Both tested sounds were supposed to be difficult for the Latvian listeners. The cardinal vowel charts indicate that the distance of the Latvian /æ/ and the RP /æ/ is even longer than that of the Latvian /e/ and the RP /e/ (see figure 12 in chapter 4). The results of the Latvian pilots do not show direct dependence between how far the tested sound is from its Latvian counterpart and the number of the correct answers. The Norwegian participants also faced more problems with the sound /e/ than with the sound /æ/. Even though it was predicted that the Norwegians might mix the /e/ with the /æ/ more often than the /æ/ with the /e/, the numbers are too small to draw any definitive conclusions. The language differences might have created some difficulties for the pilots; however, I am inclined to believe that it was also general knowledge of the target language and the other universal processes that influenced the choice of the participants.

Now I will offer a brief outline of the results for each separate word for the sound /æ/. The Latvian pilots did not mix the sound /æ/ with the sound /e/ in the word *pat* (vs. *pet*), but found it difficult to distinguish between these two sounds in the word *axe* (vs. *ex*). The Norwegian pilots faced the same problem. All of the Norwegian participants decided on the right option for the word *pat* (vs. *pet*), while 8% of the Norwegian participants did not manage to do it for the word *axe* (vs. *ex*).

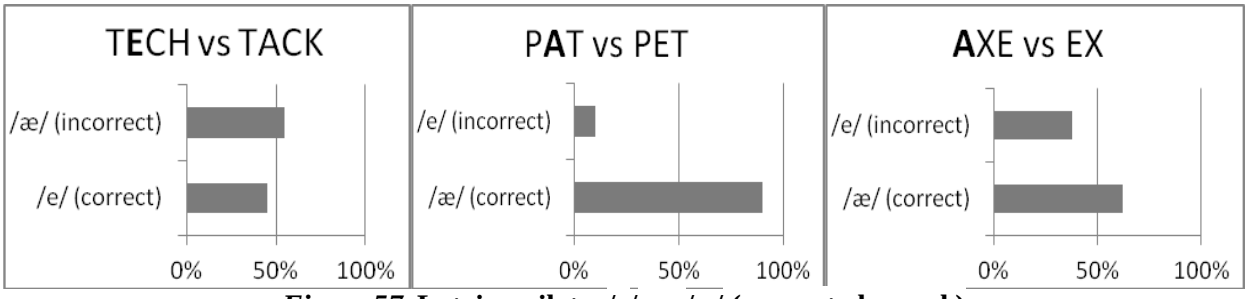


Figure 57, **Latvian pilots: /e/ vs. /æ/ (connected speech)**

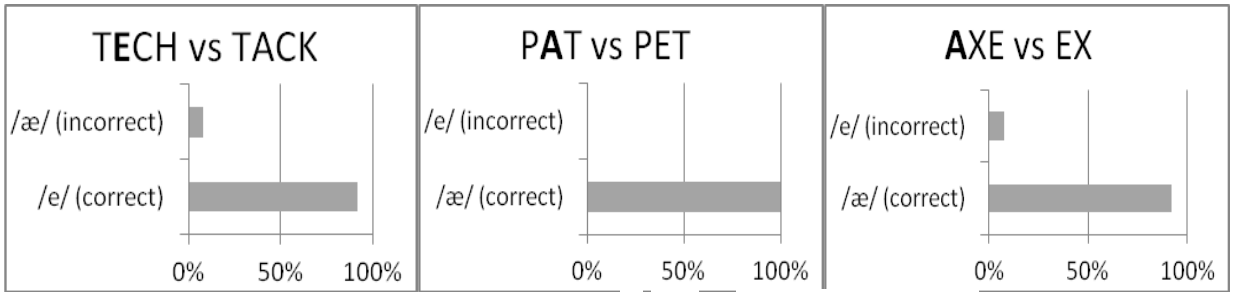


***Figure 58,* Norwegian pilots: /e/ vs. /æ/ (connected speech)**

Why did the Latvian and Norwegian test takers find it easier to recognize the word *pat* (vs. *pet*) than the word *axe* (vs. *ex*) when they contain the same sound? Certainly, there is no one reason which would shed light on the choice of the participants. It is unlikely that one of these two word pairs is more complicated than the other. However, the COCA says that the word *pat* is used ten times more frequently than the word *axe* in different contexts. In the BNC, the word *pat* occurs two times more frequently than the word *axe*. Maybe that could be one of the reasons why the pilots were better aware of its pronunciation. But how connected are the frequency of the word and familiarity with the word? These are very close variables, and, probably, dependent on one another at least to some extent. Concerning spelling, the same letters stand for the same sounds in the four tested words. In the word pair *axe* vs. *ex* the tested sounds come first. In the previous section (8.1), I mention that it might be easier to perceive the sound when the tested word starts with this sound, as it could be more easily noticeable. The results for this sound pair do not agree with my supposition. The British and American pronunciations of the tested words do not differ (*Longman Dictionary of Contemporary English*, 2009).

As for the words in isolation, the Norwegian pilots did not have any mistakes in these two word pairs at all. The Latvian pilots also demonstrated very good results, even though it was still more complicated for them to distinguish the /e/ from the /æ/ (93% correct answers) than the other way around (97% correct answers). (For detailed information, see appendix 10.)

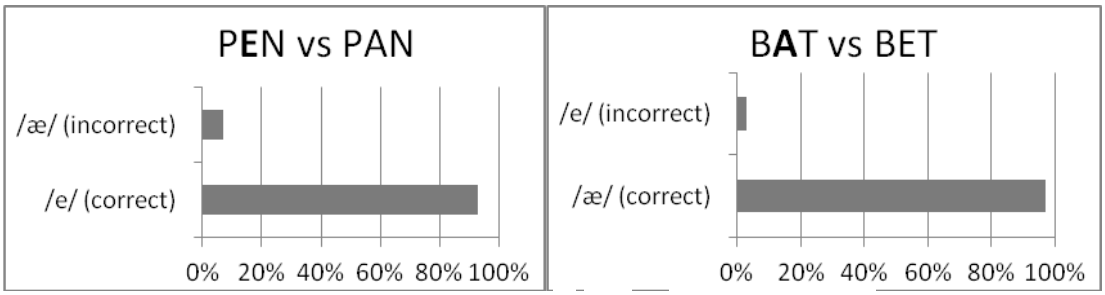


***Figure 59,* Latvian pilots: /e/ vs. /æ/ (isolated words)**

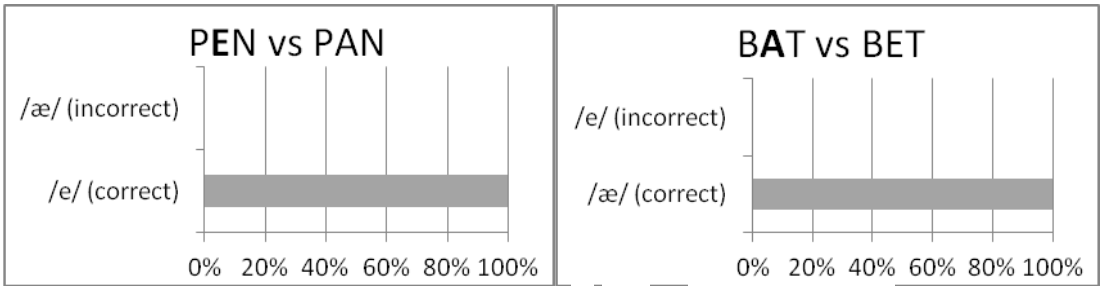


***Figure 60*, Norwegian pilots: /e/ vs. /æ/ (isolated words)**

It follows from the statistical analysis that the difference between the Latvian and Norwegian pilots is extremely statistically significant for the words with /e/ (p-value = less than 0.0001) and the words with /æ/ (p-value = less than 0.0001).

Both groups of pilots showed better results when listening to isolated words in comparison to connected speech, as hypothesized. While the Norwegians performed well in both the second and third parts of the test, the Latvian pilots did much better with the isolated words. The difference between connected speech and isolated words is statistically significant for the Norwegian participants, and very statistically significant for the Latvian participants (/e/ vs. /æ/ LV, p-value = less than 0.0001; /æ/ vs. /e/ LV, p-value = 0.0015; /e/ vs. /æ/ NO, p-value = 0.0415; /æ/ vs. /e/ NO, p-value = 0.0415).

All in all, what we see from the results for this sound pair is that it does not create problems for the Norwegians to perceive the difference between the RP /e/ and /æ/. The Latvians found it hard to distinguish between the two tested sounds in connected speech, but especially to recognize the RP /e/. The reason could be both the influence of the participants' L1s (though only to some extent, as the Norwegians were expected to mix the /e/ with the /æ/, but the Latvians to have more problems recognizing the /æ/), and the fact that Latvians are less experienced with the English language in general, causing more problems with connected speech for them than for Norwegians.

RP /u:/ vs. RP /ɔ:/

The task of the Latvian and Norwegian pilots was to distinguish between the RP /u:/ and /ɔ:/ in the words *cool down* vs. *call down*, *food* vs. *ford* and *fall* vs. *fool* in sentences 6, 15 and 24. This distinction should be easy for both Latvians and Norwegians because they have a similar distinction in their languages. The English /u:/ is more central than the Norwegian and Latvian /u:/. Therefore, it might be more difficult for them to distinguish the /u:/ from the /ɔ:/ than vise versa.

The Latvian participants managed to recognize the words with /u:/ without any problems; they gave the correct answer 95% of the time. Whereas they did very well with the words with /u:/, they recognized the word with the RP /ɔ:/ less than a half of the time (45%). The Norwegian participants demonstrated more stable results. They performed a little bit worse than the Latvians with the sound /u:/ (vs. the /ɔ:/), but much better the other way around: the Norwegians recognized the words with both tested sounds 85% of the time. (For detailed information, see appendix 9.)

Many Latvian pilots did not recognize the word with the RP /ɔ:/ but chose the one with the RP /u:/ instead, in contradiction with the hypothesis. This is an unexpected result, as it was predicted that neither the Latvians nor the Norwegians would mix these two tested sounds, as these RP sounds are very close to phonemes in their mother tongues. In fact, it was supposed that the pilots would have more problems recognizing the /u:/.

Again, let us look at how the pilots acted when it came to separate words. Unfortunately, there were two sound pairs to compare only for the words with /u:/. But it would be more interesting to look at the difference between the answers given by the Latvian respondents for the words with /ɔ:/. For both Latvian and Norwegian participants it was easier to recognize the word *food* (vs. *ford*) than the phrasal verb *cool down* (vs. *call down*), but especially for the Norwegians. As many as 97% of the Latvian and 100% of the Norwegian pilots correctly chose the word *food*, and 93% of the Latvians and 71% of the Norwegians rightly decided on the word *cool down*.

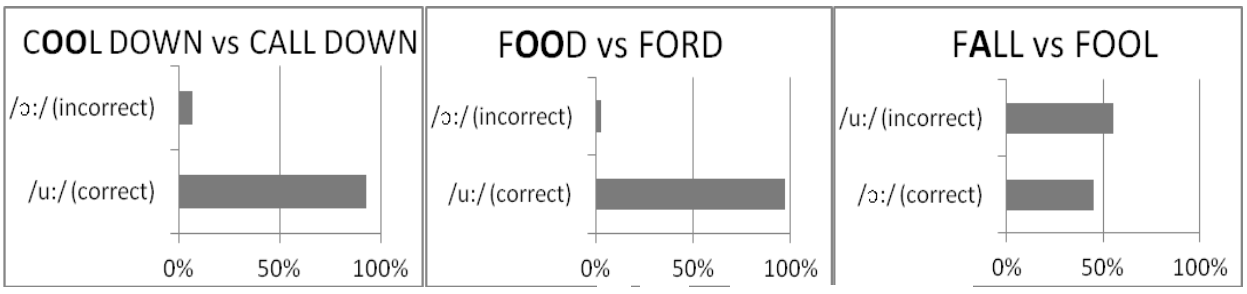


***Figure 61*, Latvian pilots: /u:/ vs. /ɔ:/ (connected speech)**

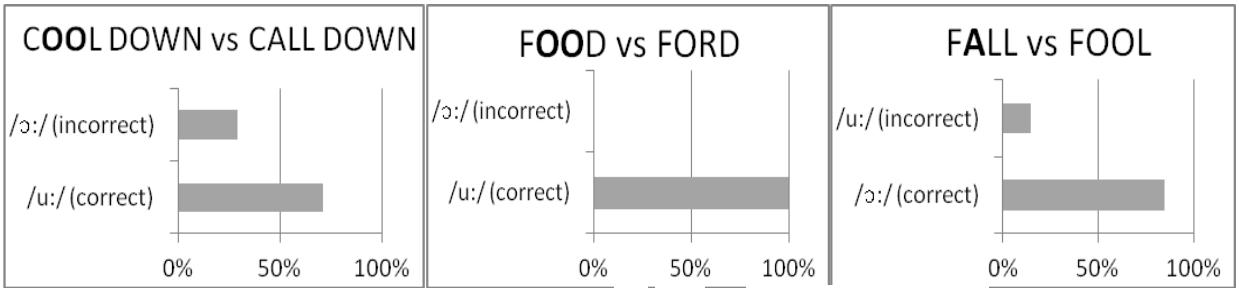


***Figure 62*, Norwegian pilots: /u:/ vs. /ɔ:/ (connected speech)**

It might be that some of the Latvian pilots do not associate the spelling *a*, as in the words *fall* or *call down*, with the sound /ɔ:/. For example, in Latvian the letter *o* stands for the sound /ɔ:/, but the two letters *oo* do not appear at all. It could be the reason why the Latvian participants made so many mistakes listening to the word *fall* (vs. *fool*).

The phrasal verbs *cool down* and *call down* are longer and more complicated than the word pair *food* and *ford*. It is not enough just to know the meaning of each element of a phrasal verb, it is necessary to know what a particular combination of several words mean. This could have contributed to the pilots' difficulties with the phrasal verbs compared to the monosyllabic nouns. Even though the pilots were provided translations of every option in the test, it might be more complicated to perceive longer and less familiar words or word combinations. The phrasal verb *cool down* is encountered only once per million words in both corpora, while the word *food* occurs 272 times per million words in the COCA and 190 times in the BNC.

The British and American variants of the pronunciation of the words *cool down* and *food* are very close to each other (*Longman Dictionary of Contemporary English*, 2009), that is why it is unlikely that this difference in English varieties could have influenced the pilots' choice in this particular case.

As for the isolated words, the Norwegians did not make any mistakes at all with the words with /u:/ and /ɔ:/. All the Latvian participants gave the correct answers for the word with /u:/, and performed two times better than before with the word with /ɔ:/ (93% correct answers). (For detailed information, see appendix 10.)

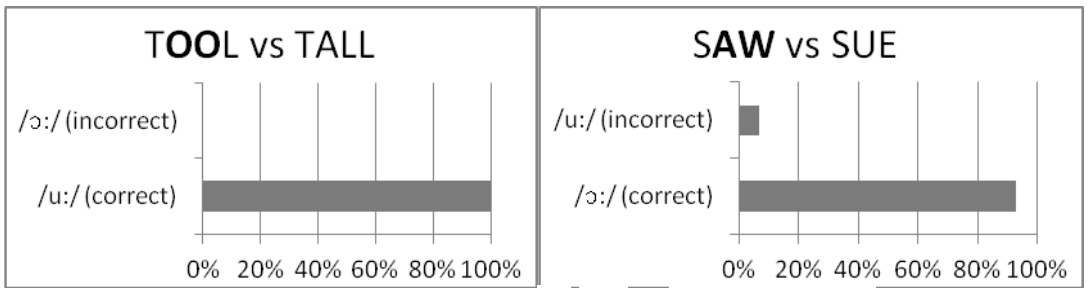


***Figure 63*, Latvian pilots: /u:/ vs. /ɔ:/ (isolated words)**

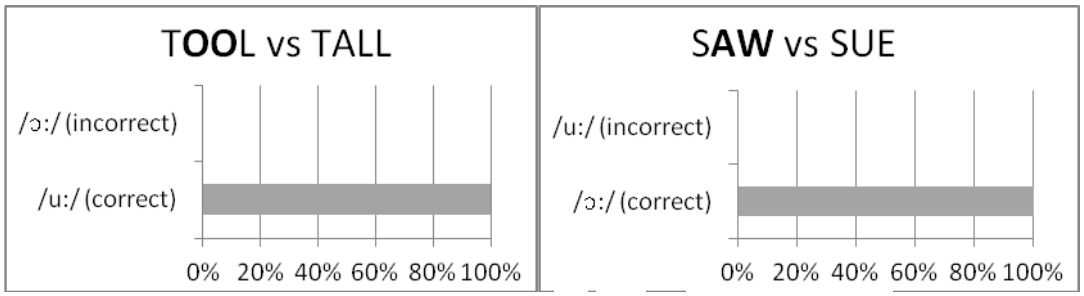


***Figure 64*, Norwegian pilots: /u:/ vs. /ɔ:/ (isolated words)**

As regards the difference between the Latvian and Norwegian pilots, it is extremely statistically significant for the words with /ɔ:/ (p-value = less than 0.0001), and not quite statistically significant for the words with /u:/ (p-value = 0.0547).

There is a considerable difference in the respondents' results between the second (connected speech) and third (isolated words) parts of the test. The results for isolated words appeared to be much better for both groups of pilots, as hypothesized. The difference between connected speech and isolated words is extremely statistically significant for the Norwegians for the words with /ɔ:/ and /u:/, and for the Latvians for the words with /ɔ:/, but not for the words with /u:/ (/ɔ:/ vs. /u:/ NO, p-value = 0.0056; /u:/ vs. /ɔ:/ NO, p-value = less than 0.0001; /ɔ:/ vs. /u:/ LV, p-value = less than 0.0001; /u:/ vs. /ɔ:/ LV, p-value = 0.0727). The reason for such a considerable difference between the connected speech and isolated words could be that connected speech creates additional challenges, but especially when the tested sound is a part of longer and less familiar utterances, as we saw in the example with phrasal verbs.

The findings indicate that the Norwegian participants found both directions (the /u:/ vs. the /ɔ:/, and the other way around) almost equally easy. The Latvian pilots faced many more problems recognizing the words with /ɔ:/. The result of the Latvian participants is not in accordance with the hypothesis, as it was expected that the words with /ɔ:/ would not create as many problems for the Latvians as it did. It is difficult to explain the reason, as the Latvian /ɔ:/ is a little bit closer than the RP /ɔ:/, but there is a smaller difference between these two sounds than

between the Latvian and the RP /u:/. Perhaps the spelling played tricks with the Latvian pilots, as in their mother tongue the letter *o* stands for the sound /ɔ:/, but never the letter *a*.

The RP diphthong /ɪə/ vs. the RP diphthong /eə/

The pilots' perception of the RP diphthongs /ɪə/ and /eə/ was tested in the words *pier* (vs. *pear*), *beer* (vs. *bear*) and *hair* (vs. *here*) in sentences 7, 16 and 25. Both groups were expected to have difficulties with these diphthongs. According to Vanvik (1975: 26), the RP diphthong /ɪə/ is often perceived as the /eə/ by Norwegian ears. That is why they were expected to have more problems with the perception of this diphthong. Vanvik also says that Norwegians tend to substitute the first element of the English /eə/ by the Norwegian /e:/ or /æ:/. However, it seems that they are unlikely to mix the two tested diphthongs due to this mistake. As for the Latvians, the Latvian /e/ and /i/ are more front and closer than both Norwegian and RP phonemes. Therefore, the perception of both the tested diphthongs might create problems for Latvian listeners. Both diphthongs might be easier for Norwegians also because they have diphthongs with a weak second part.

It turned out that the participants mixed the two tested diphthongs indeed. The Latvians recognized the words with /ɪə/ 41% of the time, and the Norwegians 53% of the time. The Latvians correctly marked the words with /eə/ 69% of the time, and the Norwegians 81% of the time. (For detailed information, see appendix 9.)

Both Latvian and Norwegian pilots had great problems with the perception of the diphthongs /ɪə/ and /eə/, but especially the Latvian participants, as predicted. The findings show that both groups of pilots found it more problematic to recognize the /ɪə/ than the /eə/.

The Latvian pilots demonstrated approximately the same results with the words *pier* and *beer*; however, it was somewhat easier for them to recognize the word *beer* (45% correct answers) than the word *pier* (38% correct answers). The Norwegians acted the opposite way. It was much easier for them to perceive the word *pier* (71% correct answers) than the word *beer* (35% correct answers).

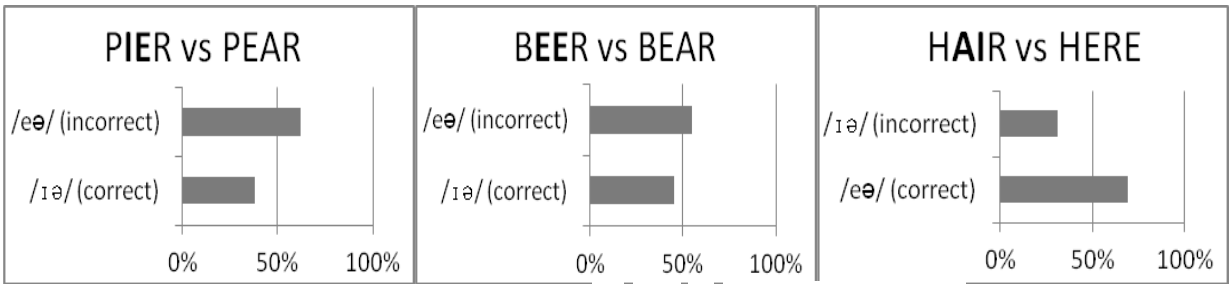


Figure 65, **Latvian pilots: /ɪə/ vs. /eə/ (connected speech)**

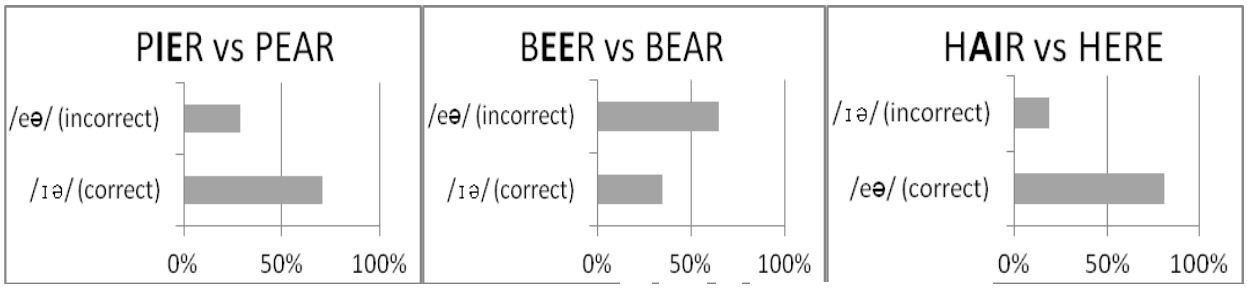


Figure 66, **Norwegian pilots: /ɪə/ vs. /eə/ (connected speech)**

Perhaps it was easier for the Latvians to recognize the word *beer* than the word *pier* because they were more familiar with the word *beer* than with the word *pier*, taking into account that their general level of English is believed to be lower than that of Norwegians. According to the COCA, the word *pier* is used almost ten times less frequently than the word *beer*: there are 5 instances per million words for the word *pier*, and 47 for the word *beer*. In the BNC, the word *pier* is used five times less frequently than the word *beer*: the word *pier* occurs 6 times, and the word *beer* 32 times per million words. The spelling of the word *pier* as if contains the tested diphthong, or at least a hint, while the spelling of the word *beer* is closer to the diphthong /eə/. However, it does not make sense when we see that they often chose the word *bear* even if the sound /ɪə/ was read. So, it is probably not the spelling that influenced the pilots' decisions.

The British and American pronunciations of the word *pier* are not the same. The tested diphthong is present only in the British variant /pɪə/, while the American variant is /pɪr/ (*Longman Dictionary of Contemporary English*, 2009). There is a similar situation with the word *beer*. The British variant is /bɪə/, while the American is /bɪr/ (*ibid*.). In American English the words would have the opposition /ɪ/ vs. /e/ (beer – /bɪr/, bear – /ber/) (*ibid*.). This difference in English varieties is unlikely to have influenced the participants' choice.

Concerning the isolated words, the pilots showed surprising results. They performed much better with the diphthong /eə/, and even worse with the diphthong /ɪə/. The Latvian participants recognized the word with the diphthong /eə/ 90% of the time, and the Norwegian

participants 100% of the time. The Latvians recognized the word with the diphthong /ɪə/ only 33% of the time, and the Norwegians only 29% of the time. (For detailed information, see appendix 10.)

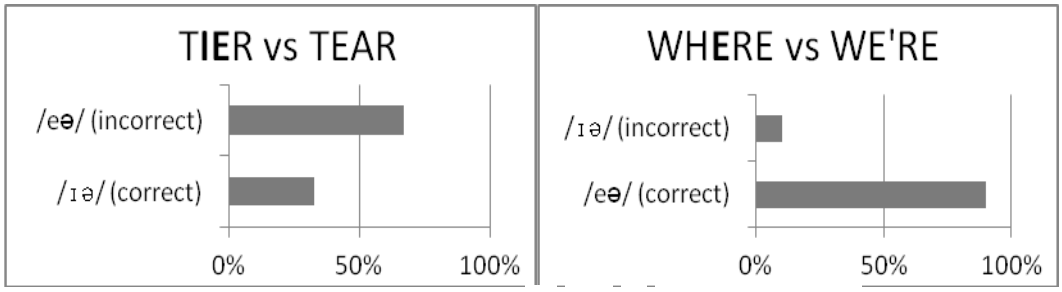


***Figure 67*, Latvian pilots: /ɪə/ vs. /eə/ (isolated words)**

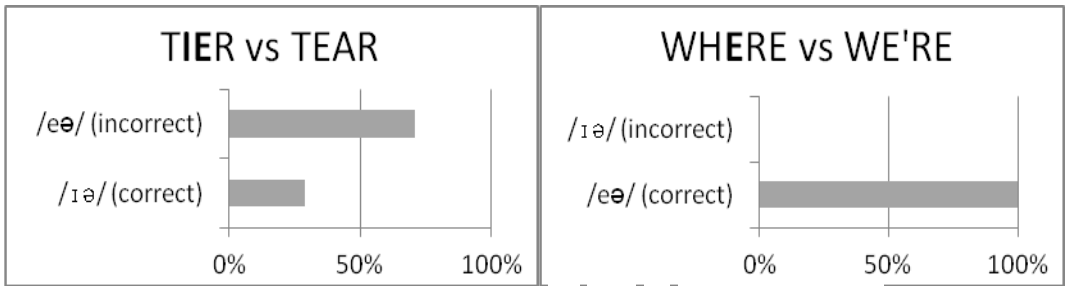


***Figure 68*, Norwegian pilots: /ɪə/ vs. /eə/ (isolated words)**

Both Latvians and Norwegians showed very similar results with the tested diphthongs, and the difference between these two groups is not statistically significant (/ɪə/ vs. /eə/, p-value = 0.3947; /eə/ vs. /ɪə/, p-value = 0.1014).

While the Norwegian participants performed better than Latvians with connected speech, and with the isolated words with /eə/, the two groups of pilots demonstrated approximately the same results with the isolated words with /ɪə/. The results of the t-test indicate that the difference between connected speech and isolated words is very statistically significant for the Norwegian pilots for the words with /ɪə/ and /eə/ (but their results are worse for the isolated words with /ɪə/, and better for the isolated words with /eə/), and for the Latvian pilots only for the words with /eə/ (their results are better for isolated words) (/ɪə/ vs. /eə/ NO, p-value = 0.0043; /eə/ vs. /ɪə/ NO, p-value = 0.0014; /ɪə/ vs. /eə/ LV, p-value = 0.4787; /eə/ vs. /ɪə/ LV, p-value = 0.0457).

There were many more participants who managed to recognize the diphthong /eə/ in isolation than in connected speech. The tested words in isolation were of the most frequently used words in a language (namely, *where* and *we're*), but the same could be said about the words *hair* and *here* tested in connected speech.

Surprisingly, both groups of pilots demonstrated worse results with the words with /ɪə/ in isolation than with the words with /ɪə/ in connected speech. It is not strange that the pilots mixed the other word pair (*ti<u>e</u>r* vs. *t<u>ea</u>r*) to the greater extent. First of all, these words are more rarely used. However, the words *b<u>ee</u>r* and *b<u>ea</u>r* are frequent words, and still the outcome is the same. Secondly, there might be a problem that I should have thought about when designing the test: the word *t<u>ea</u>r* can also mean what comes from your eyes when you cry, in which case it is pronounced the same way as *ti<u>e</u>r*. Even though the meaning "slite, rive" is given in the test, to indicate that it is the verb *t<u>ea</u>r* that is meant, the pilots might have been confused by the homonym.

The results suggest that both groups of pilots have problems with the perception of the diphthong /ɪə/ in connected speech and in isolated words, and with the diphthong /eə/ in connected speech. As predicted, the Latvian pilots faced more problems with the perception of these diphthongs, presumably due to the fact that the participants were influenced by their L1, which does not have diphthongs with the weaker second element. The Norwegians hardly surpassed the Latvians (the difference is not statistically significant) and also showed very poor results as regards the perception of these two diphthongs, but especially the diphthong /ɪə/, as hypothesized.

<u>The RP diphthong /əʊ/ vs. the RP diphthong /aʊ/</u>

The participants were listening to the words *h<u>o</u>ses* (vs. *h<u>ou</u>ses*), *n<u>o</u>* (vs. *n<u>ow</u>*) and *cl<u>ow</u>n* (vs. *cl<u>o</u>ne*) in sentences 8, 17 and 26 to test the RP diphthong /əʊ/ vs. the RP diphthong /aʊ/. The Latvian and Norwegian pilots were expected to have fewer problems with /aʊ/ than with /əʊ/, as the /a/ exists in both Latvian and Norwegian, but especially the Latvian participants, as Latvian has an /au/, but Norwegian does not have a similar "equivalent" to the RP /aʊ/. Speaking about the /ə/, there are linguists (Popperwell, 2010: 12–13; Vanvik, 1983: 26) who include it in the Norwegian sound system; however, the unstressed Norwegian /e/ is still not as central as the RP schwa. The /ə/ is not found in Latvian at all, and therefore the /əʊ/ is supposed to create even more problems for the Latvians than for the Norwegians. The second element of this diphthong, /ʊ/, is articulated differently in both Latvian and Norwegian. That is why both /əʊ/ and /aʊ/ seem to be problematic for Latvian and Norwegian pilots. As the Latvian diphthongs do not have a weaker second part, it might be more difficult for the Latvians to perceive this part.

All the Latvian and Norwegian pilots managed to recognize the word with the diphthong /aʊ/. The Latvians did not have problems with the perception of the diphthong /əʊ/ 62% of the time, and the Norwegians 93% of the time. (For detailed information, see appendix 9.)

The pilots' answers show that they did not have any problems with the perception of the diphthong /aʊ/. The Latvians and Norwegians found it easier to perceive the RP /aʊ/ than the RP /əʊ/. The hypothesis is partly validated by the collected data. As predicted, both groups of participants had more difficulties with the perception of the /əʊ/, but especially the Latvian respondents, who do not have a weaker second part of diphthongs in their mother tongue. However, it was expected that the pilots would have some problems also with the diphthong /aʊ/.

In comparison to the Norwegians, the Latvian pilots showed a great difference in the number of correct and incorrect answers when it came to separate words: 41% of the Latvians recognized the word *hoses*, and 83% the word *no*. The Norwegian participants also found it easier to recognize the word *no* (98% correct answers) than the word *hoses* (88% correct answers).

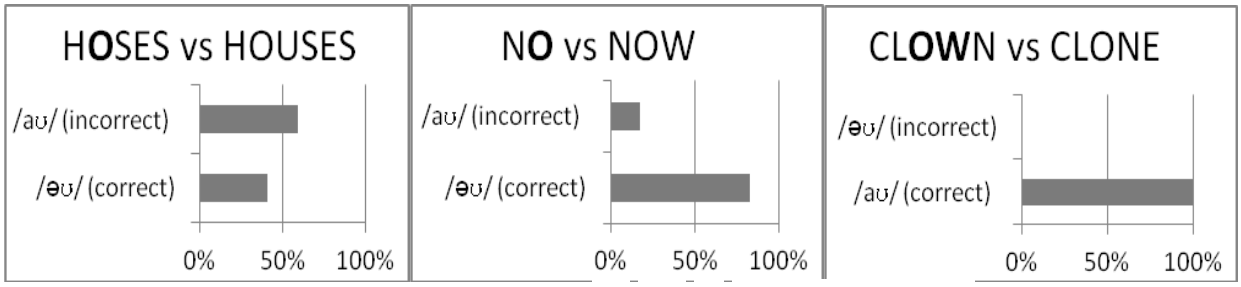


***Figure 69*, Latvian pilots: /əʊ/ vs. /aʊ/ (connected speech)**

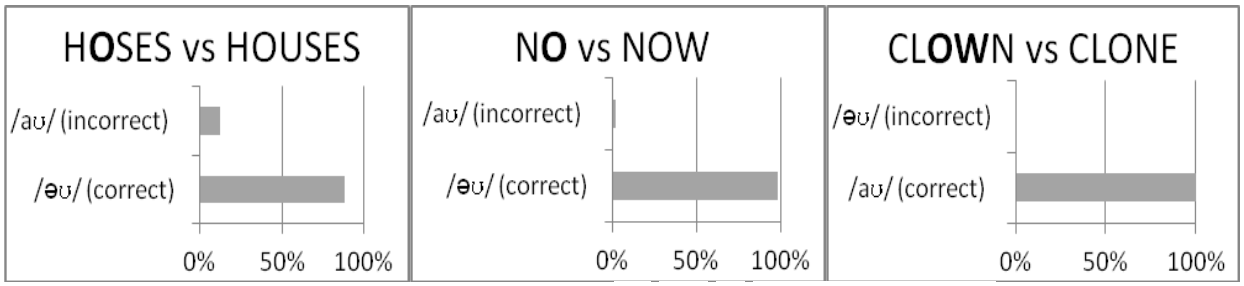


***Figure 70*, Norwegian pilots: /əʊ/ vs. /aʊ/ (connected speech)**

At first I assumed that the pilots had difficulties with the word *hoses* because this word is not that frequent, and a number of the pilots probably do not encounter this word that often in their everyday life. Especially this might be the case with the Latvian respondents, whose results were two times worse for the word *hoses* than for the word *no*. But the corpora say that the frequency

of the word *hose* is not much lower than that for many other words of the test. The word *hose* appears 6 times in the COCA, and 3 times per million words in the BNC. Obviously, the word *hose* is much less frequent than *no*, which occurs 1849 times in the COCA, and 2306 times per million words in the BNC. The fact that some pilots made mistakes even with *no* shows that it is not just a matter of frequency.

Of course, there could also be other explanations why the word *hoses* created more problems than the word *no*. The word *hoses* is longer than the word *no* and it is in the plural. Still I guess that these criteria would not be decisive if the pilots heard this word more often and were used to it. The British and American pronunciations of the word *hose* and *no* differ. The British pronunciation of these two words contains the tested RP /əʊ/ (/həʊz/, /nəʊ/), but the American the diphthong /oʊ/ (/hoʊz/, /noʊ/) (*Longman Dictionary of Contemporary English*, 2009). However, this difference does not explain why the pilots perceive diphthong better in the word *no* than in the word *hoses*. The American variant is not closer to the second tested diphthong. That is why it is unlikely to influence the pilots' choice in this tested sound pair.

Further, the task of the participants was to recognize the isolated words *crone* (vs. *crown*) and *town* (vs. *tone*) in items 8 and 17. The results are as follows: 93% of the Latvian and 100% of the Norwegian pilots recognized the word *town*, and 37% of the Latvians and 85% of the Norwegians the word *crone*. (For detailed information, see appendix 10.)

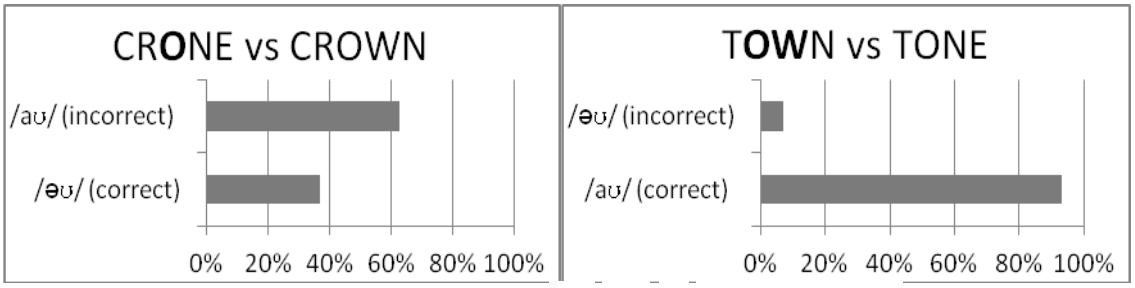


***Figure 71*, Latvian pilots: /əʊ/ vs. /aʊ/ (isolated words)**

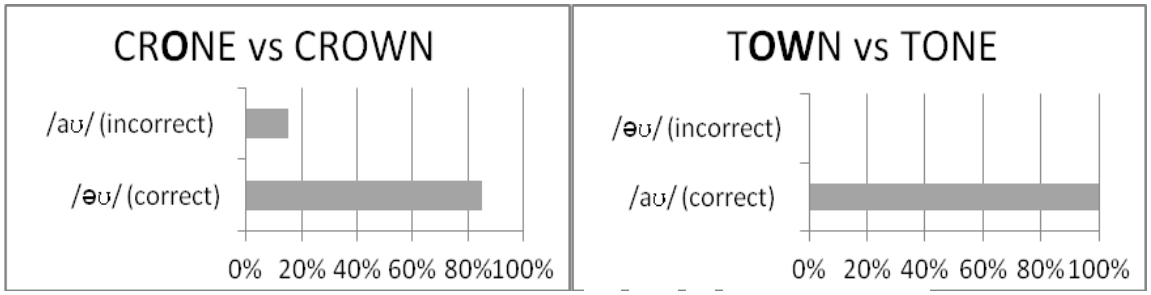


***Figure 72*, Norwegian pilots: /əʊ/ vs. /aʊ/ (isolated words)**

The difference for the words with /əʊ/ between the Latvian and Norwegian groups turned out to be extremely statistically significant (p-value = less than 0.0001), while the difference for the words with /aʊ/ not (p-value = 0.0667).

In contradiction with the predictions, both groups of pilots faced more difficulties recognizing the tested sounds in the words in isolation than in connected speech. The general picture did not change after testing the same diphthongs in isolated words, but the results for each tested item became a little bit worse. The only exception was the perfect perception of the RP /aʊ/ by the Norwegian pilots, which remained the same. According to the t-test, the difference between connected speech and isolated words reaches statistical significance only in case of the Latvian participants for the words with /əʊ/ (/əʊ/ vs. /aʊ/ LV, p-value = 0.0254; /aʊ/ vs. /əʊ/ LV, p-value = 0.1626; /əʊ/ vs. /aʊ/ NO, p-value = 0.2083; /aʊ/ vs. /əʊ/ NO, perfect data).

Were the words in isolation less frequently used and less familiar for the participants than the words tested in connected speech? The word *crone* is less frequently used than the word *hose* indeed. The frequency of the word *crone* is around 0.7 times per million words in the COCA (and for *hose* 6 times per million words), and around 0.5 times per million words in the BNC (and for the word *hose* 3). Thus the word *no* is most frequent. Now let us look at whether the pilots' answers confirm the assumption that it is easier to recognize the familiar words. It seems that it is not so. Even though it was easier for both groups of respondents to recognize the word *hoses* than the word *crone*, the situation is not the same when it comes to the words *town* and *clown*. The Latvian participants made mistakes in the word *town*, but not in the word *clown*, even though the word *town* does not seem to be less familiar.

The findings correspond to the hypothesis to some extent. The results reveal that the Latvian participants have more problems with the tested RP diphthongs than the Norwegian participants (but the difference is statistically significant only for the words with /əʊ/), probably due to the fact that they are not used to the weaker second element of the diphthongs. It was predicted that the Latvians and Norwegians might have fewer problems with the /aʊ/ than with the /əʊ/, but both of these diphthongs might be difficult for the participants. While it was the case for the Latvian participants (who, as opposed to their Norwegian colleagues, have a similar "equivalent" to the RP /aʊ/), the Norwegian pilots did not have any problems with the diphthong /aʊ/ at all, but still had some problems with the /əʊ/. In spite of the expectations, both groups of respondents demonstrated worse results with the tested sounds in isolation than in connected

speech. But the difference is statistically significant only in case of the Latvian participants for the words with /əʊ/.

The RP diphthong /eɪ/ vs. the RP diphthong /aɪ/

Sentences 9, 18 and 27 were formed to test the RP diphthongs /eɪ/ and /aɪ/. These sounds were tested in the words *tray* (vs. *try*), *mail* (vs. *mile*) and *light* (vs. *late*). This sound pair should not create difficulties for the Latvians and Norwegians, as very similar diphthongs exist in their native languages.

The Latvian pilots correctly chose the words with the diphthong /eɪ/ 90% of the time, and the Norwegian pilots 98% of the time. The Latvians correctly chose the word with the diphthong /aɪ/ 97% of the time, and the Norwegians 98% of the time. (For detailed information, see appendix 9.)

The findings do not contradict the hypothesis. The Norwegians did not find one diphthong more difficult than the other. They gave an equal number of correct answers to each of them. The Latvians faced slightly more problems with the diphthong /eɪ/ than with the diphthong /aɪ/, but had good scores for both.

Both groups of pilots made some mistakes when listening to the word *tray* (vs. *try*): 21% of the Latvians and 4% of the Norwegians chose the wrong word. Neither the Latvian nor the Norwegian participants had any problems with the word *mail* (100% right answers for both groups).

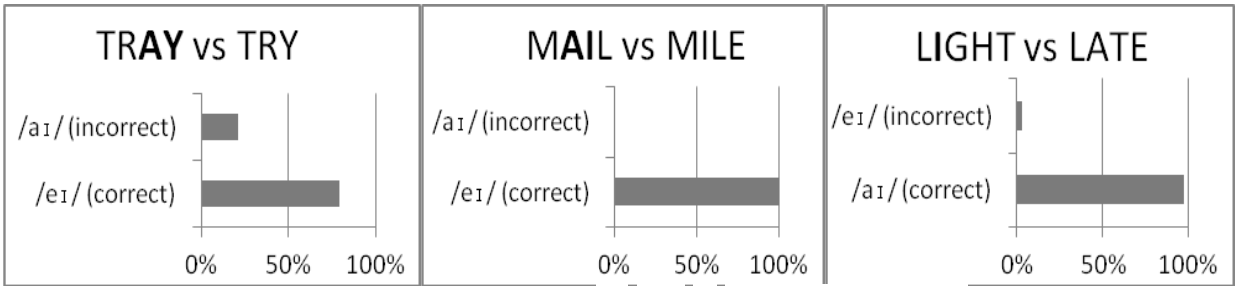


***Figure 73*, Latvian pilots: /eɪ/ vs. /aɪ/ (connected speech)**

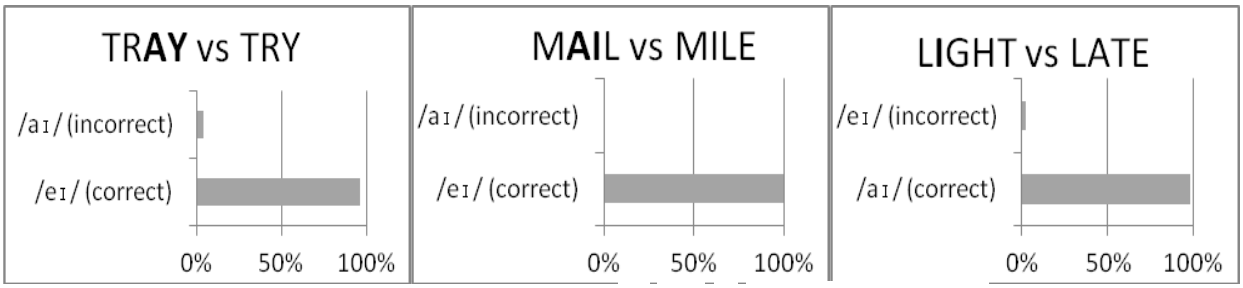


***Figure 74*, Norwegian pilots: /eɪ/ vs. /aɪ/ (connected speech)**

It could be that the Latvians faced more problems with the /eɪ/ than with the /aɪ/ due to the word choice, since they made mistakes one with one of the words containing /eɪ/ and not the other. Unfortunately, there is not enough data to check whether the Latvian pilots have more problems with the RP diphthong /eɪ/ than with the diphthong /aɪ/ indeed.

One of the reasons why the Latvian and Norwegian respondents performed better with the word *mail* than with the word *tray* could be that they are using the word *mail* more often than the other one, that is why they are well aware of its pronunciation. The spelling of these two words which stands for the tested diphthong is also different. However, there is no evidence that the spelling *ai* reminds the pilots more of the /eɪ/ than the spelling *ay* does. These two words are of the same length, and the British and American pronunciations of these words are also the same (*Longman Dictionary of Contemporary English*, 2009).

These two diphthongs were further tested in the isolated words *pay* (vs. *pie*) and *die* (vs. *day*) in items 9 and 18. All of the Latvian and Norwegian pilots managed to distinguish the RP /eɪ/ from the RP /aɪ/ in the word *pay*, and 93% of the Latvians and 98% of the Norwegians recognized the word *die*. (For detailed information, see appendix 10.)

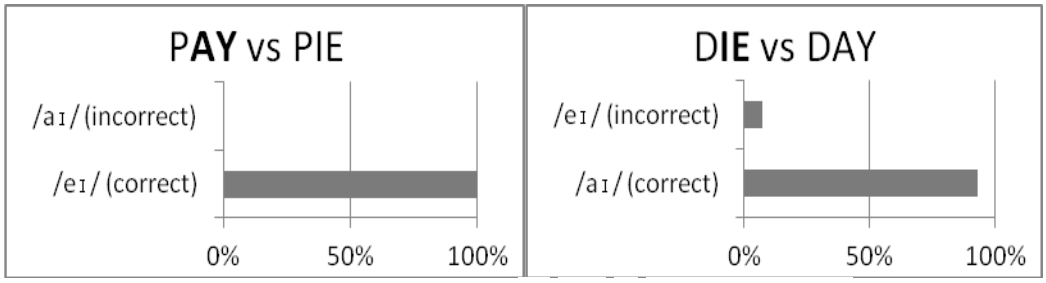


***Figure 75*, Latvian pilots: /eɪ/ vs. /aɪ/ (isolated words)**

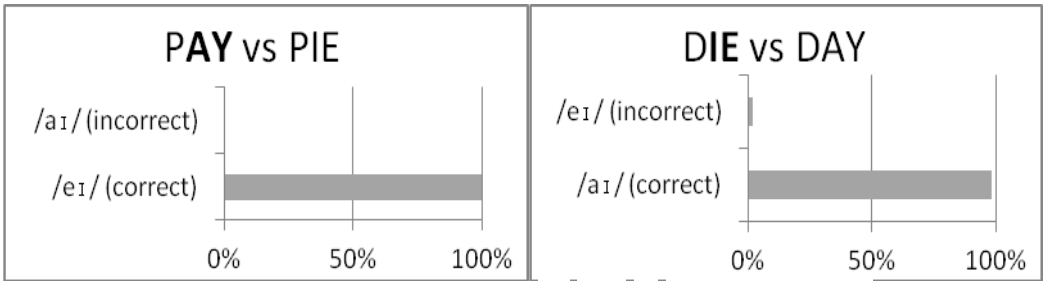


***Figure 76*, Norwegian pilots: /eɪ/ vs. /aɪ/ (isolated words)**

This time the Latvian pilots had the opposite results: they recognized the diphthong /eɪ/ better than the diphthong /aɪ/. The Norwegians acted the same way: this time they recognized the RP /eɪ/ better, while having equal results for the both tested diphthongs in connected speech.

The difference between the Latvian and Norwegian groups is statistically significant for the words with /eɪ/ (p-value = 0.0211), but not for the words with /aɪ/ (p-value = 0.3789).

The participants demonstrated slightly better results listening to isolated words than to sentences, as expected. The difference between connected speech and isolated words reaches statistical significance only in case of the Latvian test takers for the words with /eɪ/ (/eɪ/ vs. /aɪ/ LV, p-value = 0.0080; /aɪ/ vs. /eɪ/ LV, p-value = 0.5815; /eɪ/ vs. /aɪ/ NO, p-value = 0.1562; /aɪ/ vs. /eɪ/ NO, p-value = 1.0000).

Was it the word frequency that influenced the pilots' decisions? We find the tested word *pay* 190 times per million words in the COCA, and 220 times per million words in the BNC, while the word *pie* occurs only 24 times per million words in the COCA, and only 11 times per million words in the BNC. The opposite situation holds with the second word pair. The frequency of the tested word *die* is 123 instances per million words in the COCA, and 54 in the BNC. The word *day* (or its equivalent) seems to be one of the most frequently used words in the language. Its frequency is 729 times per million words in the COCA, and 611 in the BNC. It might be that the pilots performed better with the word pair *pay* vs. *pie* because they were more used to the uttered word than the second option, and performed worse with the word pair *die* vs. *day*, because the tested word was less frequently used by the participants than the alternative option.

Could the spelling have influenced the pilots' choice? The spelling of the tested diphthong is the same in the words *pay* and *tray*. However, both groups of respondents found it more difficult to recognize the /eɪ/ in the word *tray*.

The prediction was that the pilots would not have any problems with these sounds. The findings confirm that neither the Latvians nor the Norwegians had many problems with the RP diphthongs /eɪ/ and /aɪ/. Once the pilots did a little bit better with the diphthong /aɪ/, the other time not, but the majority of the participants did not mix the /eɪ/ and /aɪ/ in isolated words or connected speech. The performance of the Latvian pilots was slightly worse than that of the Norwegians (but the difference was statistically significant only for the words with /eɪ/). It could be explained by the fact that the Latvians do not have so much experience with the language (as we can see from the pilots' answers to the questionnaire, see section 7.2, and the role of English in their country, see chapter 4), and the fact that all the diphthongs of the Latvian language are more distinct and fully pronounced than the Norwegian and RP diphthongs.

Overall results of the second & third parts

First, I will shortly summarize the main findings of the second and third parts of the test. Then, I will compare different sound pairs and look at predictions.

The first tested sound pair was the /ɪ/ vs. the /e/. Even though the pilots were expected to have difficulties with these phonemes, they did not have problems distinguishing between them. It was hypothesized that correctly recognizing /ɪ/ when the alternative was /e/ might be harder for the participants. It was so only in connected speech, but the difference was small. The difference between the Latvians and Norwegians does not reach statistical significance. The difference between connected speech and isolated words is statistically significant only for the Norwegian group when the tested words had /ɪ/ (p-value = 0.0415). The Latvians and Norwegians had mistakes in different words.

The second tested sound pair was the /ʌ/ vs. the /æ/. It was predicted that the participants would not mix these two sounds, and they were included as a kind of control. The Norwegian respondents did not have many problems with the perception of the /ʌ/ and /æ/. The Latvians demonstrated worse performance than their Norwegian colleagues with both sounds, and the difference between the two groups is extremely statistically significant (/ʌ/ vs. /æ/, p-value = less than 0.0001; /æ/ vs. /ʌ/, p-value = 0.0003). Both groups had approximately the same results when distinguishing between the sounds in connected speech and in isolated words, and the difference is not statistically significant. The pilots found one and the same word more difficult than the other. The reason might be that this word was less frequently used than the other one.

Next, I dealt with the sound /ʌ/ vs. the /ɒ/. The test takers were not expected to mix the /ʌ/ and /ɒ/. However, on the basis of differences in the participants' L1s, it was predicted that the Latvians might perceive the /ɒ/ as the /ʌ/ more readily than the Norwegians. In contradiction with the expectations, it was difficult for the pilots to recognize the /ʌ/; however, as hypothesized, the Norwegians found it easier than the Latvians to recognize the /ɒ/. The difference between the Latvian and Norwegian respondents is extremely statistically significant when it comes to recognizing the /ɒ/ (p-value = 0.0002). The difference between the pilots' performance in connected speech and isolated words is not statistically significant. For unknown reasons both groups had fewer problems with one of the tested words.

The participants were asked to distinguish between words with /ə/ and/ɪ/. The Latvian participants demonstrated worse results than the Norwegians for both sounds, and the difference between the two groups is statistically significant (/ə/ vs. /ɪ/, p-value = 0.0441; /ɪ/ vs. /ə/, p-value = 0.0027). The pilots had enormous difficulties with the perception of the RP /ə/, but especially the Latvian pilots, as hypothesized. Contrary to predictions, neither group found it hard to recognize /ɪ/, and the difference between connected sentences and isolated words is not statistically significant for this direction. It was easier for both groups of pilots to recognize the RP /ə/ in isolated words than in connected speech, and this difference reaches statistical significance (LV, p-value = 0.0058; NO, p-value = 0.0366). The Latvian pilots had approximately the same results for both tested words, but the Norwegian pilots faced more problems with one word than the other. This might be explained by the differences in spelling, British and American pronunciations and the frequencies of the tested words.

The next tested sound pair was the /e/ vs. the /æ/. It did not create problems for the Norwegians to perceive the /e/ and /æ/. The Latvians often mixed the tested sounds, but especially the /e/. The difference between the performance of the Latvian and Norwegian pilots is extremely statistically significant (/e/ vs. /æ/, p-value = less than 0.0001; /æ/ vs. /e/, p-value = less than 0.0001). The results support the hypothesis only in case of the Latvians. It was predicted that both groups would have problems with the /e/, but the Latvian pilots would have difficulties with both tested sounds. The respondents showed better results when listening to isolated words, as expected, and the difference is statistically significant (/e/ vs. /æ/ LV, p-value = less than 0.0001; /æ/ vs. /e/ LV, p-value = 0.0015; /e/ vs. /æ/ NO, p-value = 0.0415; /æ/ vs. /e/ NO, p-value = 0.0415). One of the tested words was more difficult for both groups. It might be its frequency that influenced the pilots' decisions.

Further, it was tested whether the pilots mix /u:/ and /ɔ:/. These sounds were supposed to be easy for both groups. The Norwegians found both sounds almost equally easy, as hypothesized. Even though the Latvians were expected to have more problems with the perception of the /u:/, they faced difficulties with the perception of the /ɔ:/ in connected speech, and for this sound the difference between the performance of the Latvian and Norwegian pilots is extremely statistically significant (/ɔ:/ vs. /u:/, p-value = less than 0.0001). The results for connected speech turned out to be much worse for both groups. The difference between connected speech and isolated words is extremely statistically significant for the Norwegians for the words with /ɔ:/ and /u:/, and for the Latvians for the words with /ɔ:/ (/ɔ:/ vs. /u:/ NO, p-value = 0.0056; /u:/ vs. /ɔ:/ NO, p-value = less than 0.0001; /ɔ:/ vs. /u:/ LV, p-value = less than 0.0001). It was easier for both groups to recognize one of the words that tested the same sound. The reason might be the differences in spelling, length and frequency of the tested words.

The pilots also had to distinguish the /ɪə/ from the /eə/. Both groups showed very poor results as regards the perception of the diphthong /ɪə/, as hypothesized. It was difficult for the participants to perceive this diphthong both in connected speech and in isolated words, and the results for isolated words are even worse in comparison to connected speech. For Norwegians the difference between the connected speech and isolated words reaches statistical significance (/ɪə/ vs. /eə/ NO, p-value = 0.0043). As for the opposite direction, the pilots had problems with the diphthong /eə/ only in connected speech, and the difference between connected speech and isolated words is very statistically significant for both groups of participants (/eə/ vs. /ɪə/ LV, p-value = 0.0457; /eə/ vs. /ɪə/ NO, p-value = 0.0014). The difference between the Latvians and Norwegians does not reach statistical significance, as the Norwegians almost did not surpass the Latvians. It was easier for the Latvians to recognize the tested sound in one word, but for the Norwegians in the other.

Then, I tested the pilots' perception of the /əʊ/ and /aʊ/. It was predicted that the respondents would have problems with both of these diphthongs, but more with the diphthong /əʊ/. This was the case for the Latvians, but the Norwegians experienced difficulties only with the /əʊ/, not with /aʊ/. The difference between the Latvian and Norwegian pilots was extremely statistically significant for /əʊ/ (p-value = less than 0.0001), and not significant for /aʊ/. The results of the t-test show that the difference between connected speech and isolated words reaches statistical significance only in case of the Latvian participants for the perception of /əʊ/ (p-value = 0.0254). Both groups found it easier to perceive /əʊ/ in one of the two words which

contained this diphthong. The reasons might be that this word was longer, it was in the plural and less frequently used.

The last tested sound pair was /eɪ/ vs. /aɪ/. The pilots in both groups did not mix these tested sounds most of the time, as predicted. The difference between the Latvian and Norwegian groups is statistically significant only for the recognition of /eɪ/ (p-value = 0.0211), but the Latvians did not make many mistakes here either. Although both groups demonstrated slightly better results listening to isolated words than to sentences, the difference between connected speech and isolated words is significant only in case of the Latvian pilots for the same sound (/eɪ/ LV, p-value = 0.0080). The Latvian and Norwegian participants found it more problematic to recognize /eɪ/ in one of the words with this sound. The reason might be that this word is more frequently used than the other one.

According to my observations, it was most difficult for both groups of pilots to distinguish the /ə/ from the /ɪ/, the /ɪə/ from the /eə/ and the /ʌ/ from the /ɒ/. The Latvians also had problems with the /əʊ/ vs. the /aʊ/ in both connected speech and isolated words, and with the /e/ vs. the /æ/, and the /ɔ:/ vs. the /u:/ only in connected speech. There were quite many phonemes which did not create particular difficulties for the participants.

My main objective was to find out whether there is L1 influence, and that can be detected if the Latvians and Norwegians are different in ways that are explainable on the basis of differences in their L1s. Even though we see that in many cases the Latvian and Norwegian participants had difficulties with the same sounds (but some of these sounds were expected to cause the same reaction on the part of both groups), sometimes the Latvians made other mistakes than the Norwegians. The analysis of these mistakes gives clear indication that there is an influence of L1 on L2 perception; however, there are also other factors which interact. I will provide some examples.

I will start with the phonemes which were predicted to be perceived differently by the Latvians and Norwegians, and where the predictions were confirmed. The Latvians were expected to choose the words with /ʌ/ when the target had /ɒ/ more readily than the Norwegians, because the Latvian /ɔ/ is not as close to the RP /ɒ/ as the Norwegian /ɔ/ is. As hypothesized, the Latvians had more problems with choosing the words with /ɒ/ than the Norwegians, but did not have more problems than their colleagues with choosing the words with /ʌ/. The results of the statistical analysis show that the difference between the Latvian and Norwegian pilots was extremely statistically significant when it comes to the words with /ɒ/ (p-value = 0.0002), but

was not significant for the words with /ʌ/ (p-value = 0.8793). There is a similar situation with the next tested sound. The Latvians were supposed to find it harder to recognize the /ə/ than the Norwegians, because they do not have any similar sound in their native language, and also were believed to have more problems with the /ə/ than with the /ɪ/ for the same reason. The findings support these hypotheses. However, the difference between the Latvians and Norwegians is statistically significant for the words with /ə/ (p-value = 0.0441), and the words with /ɪ/ (p-value = 0.0027). The results for the words with /ɪ/ also might be influenced by the L1 of the participants, as the Latvian /i/ is more front and closer than the RP and Norwegian sounds.

It was hypothesized that the Latvian pilots might choose the words with /e/ when the target had /æ/ more readily than the other way round, as the Latvian /æ/ is closer and less front than the Norwegian and RP phonemes. The Latvians experienced more difficulties with the words with /æ/ indeed. Still, we cannot say for sure that the reason was language transfer, as the Latvians had weaker results also for the words with /e/, and the difference between the Latvians and Norwegians is extremely statistically significant for both the words with /e/ (p-value = less than 0.0001) and the words with /æ/ (p-value = less than 0.0001).

The diphthong /aʊ/ was expected to create fewer problems for the participants than the /əʊ/, as the /a/ exists in both Latvian and Norwegian, and Latvian even has a similar "equivalent" /au/. The /əʊ/ was predicted to be more difficult for the Latvians, as Latvian does not have the schwa. The results meet the expectations. The difference between the Latvian and Norwegian groups for the words with /əʊ/ turned out to be extremely statistically significant (p-value = less than 0.0001), while the difference for the words with /aʊ/ is not statistically significant (p-value = 0.0667).

I will proceed with the examples where the Latvians and Norwegians were expected to have similar results due to the similarities in their languages. It was predicted that the /ɪ/ is more likely to be heard as the /e/ than opposite for both groups, as the RP /ɪ/ is more open than the Latvian and Norwegian counterpart and closer to their /e/. Both groups of pilots found it easier to recognize the words with /e/ indeed, but only in connected speech. The results for the isolated words do not reveal any difference. Another example is the sound pair /eɪ/ vs. /aɪ/. Neither group was expected to have any problems with these phonemes, because similar diphthongs exist in their mother tongues, and the findings agree with the hypothesis.

The findings do not show that the RP sounds that differ more in position from their Latvian and Norwegian counterparts are more difficult to recognize than the ones close to each

other. While both groups experienced particular difficulties with the RP schwa, which does not exist in Latvian and is different in Norwegian, and the diphthong /əʊ/, which is not found in either language, there are many cases when the sounds which differ more in position turned out to be easier for the Latvian and Norwegian participants. For example, the pilots had more problems with the /ʌ/ than with the /æ/ or the /ɒ/, even though the Latvian and Norwegian counterparts of the /æ/ and /ɒ/ differ more in position from the RP phonemes than that of the /ʌ/. The Latvian /æ/ is the same distance from the RP /æ/ as the Latvian /e/ from the RP /e/, but the Latvians demonstrated worse results for the /e/ than for the /æ/.

As we see from the above, there are signs of L1 influence, but there are also sounds which do not fit the patterns. The sound pair /ɪ/ vs. /e/ was expected to be difficult for both groups of pilots, because these sounds are articulated differently in English than in the pilots' L1s. But the participants did not face difficulties with this sound pair. It was predicted that the pilots might not mix the /ʌ/ with the /æ/ and /ɒ/, because they have similar distinctions in their L1s. But if they still do, then they might mix the /ʌ/ with the /æ/ more readily than with the /ɒ/, because the /æ/ is unrounded like the /ʌ/. However, they had considerable difficulties with the perception of the /ʌ/, and confused the /ʌ/ with the /æ/ more often than with the /ɒ/. It was hypothesized that the Norwegians might have more problems recognizing the words with /ɪ/ (vs. /ə/), as the RP /ɪ/ is more central and open than the Norwegian /i/, but they had hardly any mistakes for the words with /ɪ/. Both groups were likely to choose the words with /æ/ when the target had /e/, because the position of the /e/ represents one of the major differences between the three languages. The Norwegians did not find it hard to distinguish between these sounds in spite of the language differences. The participants were expected to find it easier to recognize the words with /ɔ:/ than the other way around, as the English /u:/ is more central than the Norwegian and Latvian /u:/, while the position of the /ɔ:/ does not differ that much in these three languages. In contradiction to the predictions, the Latvian respondents experienced more difficulties with the /ɔ:/ vs. the /u:/.

In some cases I noticed likely reasons for misfits. For example, it might be that the Norwegians did not find it problematic to recognize the RP /ɪ/ and /e/ because their general level of English proficiency was quite high, and they were well aware of the pronunciation of the tested words. The reason why the pilots demonstrated better results recognizing the words with /ʌ/ (vs. /æ/) than the words with /ʌ/ (vs. /ɒ/) might not have been connected with the fact that both /ʌ/ and /æ/ are unrounded sounds (the pilots were expected to mix the /ʌ/ with the /æ/ more

likely than with the /ɒ/ because the /æ/ is unrounded like the /ʌ/). The reason might be that the Norwegian and RP /æ/ are more similar than the Norwegian /ɔ/ and the RP /ɒ/. The Latvian and RP /æ/, and the Latvian /ɔ/ and the RP /ɒ/ are both some distance from each other. But perhaps the distance is shorter for the /æ/ sounds. The fact that the pilots found it difficult to recognize the /ʌ/ could have something to do with spelling. The spelling *u*, which usually stands for the English /ʌ/, is used for the sound /u/ in Latvian, and for the sound /ʉ/ in Norwegian.

In an attempt to include some comparison of the evidence for and against L1 transfer, I counted whether there are more cases where my predictions were fulfilled than not. My hypotheses based on L1 transfer are partly validated in eight out of nine tested sound pairs, and are absolutely validated in one sound pair (/eɪ/ vs. /aɪ/). This means that the participants are influenced by their mother tongues, but that there are also other influences. There are some unpredicted results which can be explained in other ways. However, most of the unpredicted results cannot be explained on the basis of this study, and will have to be investigated further in future research.

The control sound pairs the /ʌ/ vs. the /æ/ and the /ʌ/ vs. the /ɒ/ were included in the second and third parts of the test in order to compare the cases when the pilots were asked to distinguish between the /ʌ/ and the counterpart sounds /a/ (for Latvians) and /ø/ (for Norwegians) (which were tested in the first part), and between the /ʌ/ and the other two RP phonemes, the /æ/ and /ɒ/. It was hypothesized that the participants would be influenced by their L1s and would mix the /ʌ/ with the /a/ and /ø/, but not with the RP phonemes. It follows from the answers that the participants had better results for the words with /ʌ/ (vs. /æ/), but not for the words with /ʌ/ (vs. /ɒ/) or the words with /ʌ/ (vs. /a/ and /ø/). This example illustrates that the participants are influenced by their L1s, but there are also other influences, because they did not always tend to mistake the heard sound only for the closest sound of their native language. It is interesting that both groups demonstrated approximately the same results: they found it easier to distinguish between the /ʌ/ and /æ/ than between the /ʌ/ and /ɒ/, and the /ʌ/, /a/ and /ø/. It means that something affects both groups in a same way, but this study cannot say what it is.

We also see that often both Latvians and Norwegians found the same word the most difficult to perceive when there were two words targeting the same sound. The difference in length and the difference between British and American pronunciations of the tested words do not seem to be important factors which might have influenced the listeners' decisions. The spelling and especially the frequency of the tested words seem to be more weighty factors which

are likely to have affected the listeners' choice. However, there were many cases when these factors did not seem to be at work. There might be also other processes which influenced the participants' perception, but further research is needed to test what it is.

I compared the difference between the results of the Latvians and Norwegians, and came to the conclusion that the Latvians have more problems with the perception of the RP sounds than the Norwegians do, and are more likely to mix English phonemes. In seven out of nine tested cases, the Latvians demonstrated worse results than the Norwegians at least for one of the two directions, and in each of these cases the difference between the Latvian and Norwegian groups is statistically significant.

Then, I compared the results of the second and third parts of the test in order to check whether connected speech creates additional problems in ambiguous contexts. It seems that it is more difficult for the listeners to recognize the sounds in connected speech than in isolated words indeed. In most of the cases the participants found it easier to distinguish between the tested RP phonemes in isolated words than in connected speech, and the difference between the pilots' results for connected speech and isolated words is mostly statistically significant. The findings do not show that the Norwegians, who had fewer problems with the perception of the RP sounds in general, found it easier to perceive the sounds in connected speech in comparison to isolated words than the Latvians. There were seven cases out of nine when connected speech created more difficulties than isolated words in case of the Norwegians, and five cases out of nine in case of the Latvians (I counted only the cases when the difference reached statistical significance).

There were two times when the sounds in isolated words turned out to be more difficult to recognize than the sounds in connected speech (when the difference is statistically significant), once for the Norwegians for the words with /ɪə/, and once for the Latvians for the words with /əʊ/. The reason could be that the results for the /ɪə/ (vs. /eə/) for isolated words might be inaccurate. One of the tasks of the pilots was to recognize the diphthong /ɪə/ in the word *tear*, and I gave the meaning "slite, rive" in the test in order to indicate that it was a verb. However, the respondents might have been confused by the homonym, the noun *tear*, which means what comes from your eyes when you cry. In this case the pronunciation is the same as in the word *tier*. As for the second case, I do not see any reason why the Latvians found it easier to recognize the /əʊ/ in connected speech than in isolated words. Neither the spelling nor the frequency of the tested words seems to play any role in this case.

The results of the second and third parts of the test indicate that the pilots' perception problems do not have to do only with the specific nuance of the sound, but they also affect the ability to distinguish between English phonemes which, unfortunately, could cause misunderstandings. These problems are partly connected to language transfer, and partly to other processes which influence the listeners' decisions. The Latvian pilots tend to confuse English phonemes more than the Norwegian pilots, but sound perception in connected speech is more problematic than sound perception in isolated words for both groups of participants.

In the next chapter I will draw conclusions: I will answer the research questions, give a summary of the main findings and suggest how the results can be used in practice. I will also point out the pilots' comments and suggestions obtained from the questionnaire, say a few words about the limitations of this study and recommend questions for further investigation.

9 Conclusion

The main objective of this study was to find out whether there is L1 influence in sound perception, which could be detected if the Latvians and Norwegians demonstrated different results that would be explicable on the basis of differences in their native languages. The results indicate that often the Norwegians and Latvians found the same sounds and the same words more difficult, which means that there are universal influences which affect both groups in a similar way. In the first part, both groups mixed most of the tested phonemes with their native phonemes, but the most difficult sounds for both groups were the sounds /ɜ:/, /ə/ and /ɪə/, and the easiest the phonemes /eə/ and /ɑ:/. The diphthong /ʊə/ created special difficulties only for the Latvian participants. Unfortunately, the pilots tended to confuse not only the RP phonemes with their native phonemes, but also failed to distinguish between some RP phonemes, which can lead to misunderstandings in real-life situations. In the second and third parts, both groups of pilots mixed the RP phonemes /ə/ and /ɪ/, /ɪə/ and /eə/, and /ʌ/ and /ɒ/. Sometimes the spelling and frequency of the tested words were likely to influence the pilots' decisions. The respondents from both groups might have chosen a certain variant because they thought that the particular spelling corresponded to the tested sound, but not the other spelling. Perhaps some of the tested words were unfamiliar to the participants (and they were not frequently used or less frequently used in the language than the other tested words). There were still many cases where these explanations did not seem to fit.

Nevertheless, in most of the cases where the Latvians and Norwegians made different mistakes, there were signs of L1 influence, which means that their previous knowledge of L1s also has an influence on the perception of the L2. In the first part of the test, the Latvians confused the tested RP sounds with the Latvian sounds more often than the Norwegians did, and the difference between the two groups reaches statistical significance in all of the tested cases. As for the Norwegian participants, they also followed the predictions based on language transfer. In the second and third parts of the test, the results also more often than not agreed with the predictions which were based on the differences in the pilots' L1s. However, the results do not show that the RP sounds that differ more in position from their Latvian and Norwegian counterparts are more difficult to recognize than the ones closer to the Latvian/Norwegian phonemes. At least, there was no direct dependence between the distance of the tested RP sounds and their Latvian and Norwegian counterparts, and the perception of the RP sounds.

The findings show that connected speech creates additional problems for listeners. The participants found it easier to recognize the tested RP phonemes in isolated words than in connected speech, and the difference between the pilots' results for connected speech and isolated words is statistically significant in most of the cases.

The collected data support the hypothesis that the Latvian pilots have more problems with the perception of English sounds than the Norwegian pilots. In three out of eight tested cases in the first part, and in seven out of nine tested cases in the second and third parts, the Latvian respondents demonstrated worse results than their Norwegian colleagues, and in each of these cases the difference between the Latvian and Norwegian groups is statistically significant. The mean result of the Norwegian participants (M) constitutes 52.08, and of the Latvians 44.6, which means that the average result of the Norwegians is higher than that of the Latvians. According to the distribution of correct answers of the two groups of pilots, the Norwegians have more homogeneous results, with a variance of 3.64 standard deviations, while the Latvians had a variance of 5.13 standard deviations. These findings show that the whole group of Norwegian participants has high results. As for the Latvians, there is a larger gap between those who are good at perceiving English sounds and those who have difficulties.

The results do not show any clear relationship between level of English language proficiency and amount of language transfer: the Norwegian pilots demonstrated better results in their perception of the RP sounds throughout the whole test, but when comparing the types of mistakes that the two groups did, it is difficult to say that one was more influenced by the mother tongue than the other (see pp. 109–110).

The findings do not indicate that the Latvians, who had more problems with the perception of the RP sounds in general, faced more difficulties than the Norwegians with the perception of the sounds in connected speech in comparison to isolated words.

The prediction that the Latvian participants would demonstrate worse results initially was based on the fact that English is more widely used in Norway than in Latvia. In Latvia, English is acquired only through study with the help of guidance and is hardly ever used in naturally occurring social situations. In contrast, in Norway, English has to some extent spread into everyday discourse and some claim that it is more similar to a second than a foreign language. After the collection of data, this supposition was supported by the Latvian pilots' answers to the questionnaire, where the majority of the participants confirmed that, as opposed to their Norwegian colleagues, they had never had English as a language of instruction, they suffered

from a lack of everyday practice with the language, and none of them had been assessed as proficient at Expert level 6.

There may be one more reason why the Latvians have more problems with the perception of English sounds than the Norwegians: the results of my contrastive analysis show that the Latvian sound system is further from the RP sound system than the Norwegian one. Taking into account that the listeners tend to assimilate L2 sounds to L1 sounds at least to some extent, it is natural that it is more difficult for the Latvians to perceive the RP phonemes than for the Norwegians, as their native language is more different from the target language than Norwegian is.

Both groups of pilots confirmed that they have certain problems with English. While the majority of the Norwegian pilots evaluated their listening skills as good, and none of them evaluated their skills as unsatisfactory, the Latvian pilots were more self-critical. Most of the Latvian pilots evaluated their listening skills as medium or satisfactory, and some of them as unsatisfactory. As many as 46% of the Norwegian and 83% of the Latvian respondents were dissatisfied with the existing system of language training and testing, and wanted to introduce changes. The Norwegians provided more argumentation to support their opinion: they complained that plain language is not taught properly in contrast with the standard phraseology; pilots do not have easy access to study materials; the teachers and examiners are not competent enough, as most often they are their more experienced colleagues, but not language specialists; there are no formal training requirements, which makes it problematic to communicate with colleagues from Eastern Europe as their colleagues do not have enough language training and often do not understand what Norwegian pilots are saying; Norwegian pilots do not have enough preparation for the ICAO examination, etc.

On the basis of the findings of this study I would suggest that there be different language teaching programmes for Latvians and Norwegians, or at least that some differences be pointed out. It follows from the results that it is easier to perceive the sounds in more frequently used words. Therefore, it might be useful to improve the general level of English language proficiency in the Latvian pilots, to widen their English language vocabulary, and to create opportunities for communication in more natural environments rather than in a "classroom setting" only. Perhaps this could be done by inviting native speakers into the classroom, by sending Latvian pilots to take language courses in the UK, by watching English movies, by having syllabus texts in English and inviting foreign pilots to work for Latvian airlines. As regards the Norwegians, it

would probably be worth introducing some courses on English phonetics and language perception focussing on their problematic areas, as, according to the pilots' answers to the questionnaire, there were more Norwegian pilots than Latvian pilots who did not have any special English language training. It seems to me that the Norwegians have many opportunities to communicate in natural settings, and it will not be a problem to apply their knowledge in practice. Of course, such phonetic classes would be helpful also for the Latvians, but they are unlikely to make use of the theoretical knowledge unless they have an application for it in real life.

The findings of L1 influence are important when it comes to the construction of teaching materials. The findings show that separate materials rather than global ones whould be an advantage, and that there should be more focus on and training with sounds that the students are more likely to have problems with. The results of this study can be applied in the training of L2 pronunciation and perception, as they suggest which nuances to focus on.

Limitations and suggestions for further research

One of the important limitations of this study is a lack of control group. In some cases the pilots had very few mistakes. It would have been useful if I had had a control group of British pilots to compare with, because sometimes native speakers make mistakes too. So even with a few mistakes, the non-natives might still be performing in a native-like way.

As Latvian vowel phonemes were indicated outside the vowel charts in the available literature, I placed Latvian monophthongs and diphthongs in the charts myself according to the descriptions of vowel qualities found in Grigorjevs (2008: 199) and Kaurāte *et al*. (1985: 37–44). That is why I assume that the placement of the Latvian phonemes could be a little bit different than the charts indicate. It might have negatively influenced the results, as, when formulating hypotheses, I based predictions not only on the theoretical descriptions of the phoneme systems, but also on the phonemes' positions in the charts.

The linguist whose voice was recorded in the exercises, Stenbrenden, had only a theoretical knowledge of Latvian. Therefore, the Latvian counterpart sounds recorded in the first part of the test might not be pronounced exactly like a Latvian would pronounce them. It might have negatively influenced the results of the test, as it could be that the Latvian pilots did not always associate the heard "counterpart sounds" with the authentic sounds of their native language. Stenbrenden is a specialist in English phonetics and her pronunciation is native-

speaker-like. A native speaker of English equally would not have known how to pronounce the Norwegian and Latvian sounds, which is why I went for a phonologist who could produce accurate IPA sounds.

Real languages often have sounds which are not quite the IPA ones, and so we may have to use the closest equivalent symbol. The Latvian /æ/ is intermediate between /ɛ/ and /æ/, so either symbol is not quite right, and not quite wrong... In my thesis the Latvian /æ/ is transcribed as /æ/, but it may not have been exactly like Latvian /æ/. Had Stenbrenden used an authentic Latvian sound, the results may have been different. But this does not invalidate the general findings.

In this study I was trying to answer research questions regarding language-specific perception problems. This study has demonstrated the influence of the L1 on the L2 perception, but it did not shed light on many other processes which also have an impact on speech perception. Some of these processes were introduced at the beginning of the study to show that the problem is not as one-sided as it is presented further. However, in order to research other influences on speech perception a larger-scale study is needed.

In the second part of the test I checked how the pilots perceive vowel sounds in connected speech. Unfortunately, due to time and space limitations the speech was not as "connected" as it could have been. I tested how the pilots perceive the RP phonemes in sentences, but it would be better to take longer speech samples to gather more reliable results. In addition, in the theoretical part of this study I touched upon reduction processes which occur in connected speech, but I did not test how specific reduction processes influenced the perception of the Latvian and Norwegian participants. Even though it was not the core of this study, it would be interesting to see how the reduction processes influence speech perception, and whether it would explain the choice of the participants in some particular cases.

I want to say a few words about the importance of studying consonants. As already mentioned, previous research shows that consonants are not of less importance than vowels in speech perception, and the problems with the perception of consonants are as likely a source of miscommunication as the problems with the perception of vowels. Furthermore, consonants more than vowels take part in reduction processes which occur in connected speech. For further research, I would recommend studying also consonants and concentrating more on connected speech, which, as we see from the findings of this study, creates additional challenges for listeners.

In hindsight, I see that it would have been good to have controlled for frequencies, pronunciation and spelling when designing the test. If I had chosen words that were similar in these respects, it would have been clearer whether L1 influence was the important factor. In connection with that, I suggest further research on the influence of these factors on speech perception.

List of references

Aiguo, W. (2005), "Application of ESP theory into aviation English teaching in the Chinese context." *ESP Malaysia*. 11, 65–72.

Air Accidents Investigation Branch (AAIB). (1977), *British Airways Trident G-AWZT, InexAdria DC-9 YU-AJR: Report on the Collision in the Zagreb Area, Yugoslavia, on 10 September 1976.* Aircraft Accident Report 5/77. London: Her Majesty's Stationery Office.

Albert, M., L., Obler, L., K. (1978), *The Bilingual Brain: Neuropsychological and Neurolinguistic Aspects of Bilingualism.* New York: Academic Press.

Alderson, J. C. (2009), "Air safety, language assessment policy, and policy implementation: the case of aviation English." *Annual Review of Applied Linguistics*. 29, 168–187.

Allport, D., A. (1987), "Selection for action: some behavioral and neuropsychological considerations of attention and action." In Heuer, H., Sanders, A., F. (eds.), *Perspectives on Perception and Action.* Hillsdale, NJ: Laurence Erlbaum Associates.

Allport, D., A. (1993), "Attention and control. Have we been asking the wrong questions? A critical review of twenty-five years." In Meyer, D., E., Kornblum, S. (eds.), *Attention and Performance XIV. Synergies in Experimental Psychology, Artificial Intelligence, and Cognitive Neuroscience.* Cambridge: MIT Press.

Almberg, J. (2000), "Kor fort snakkar vi eigentleg?" *Nordlyd*. 28, 60–73.

Andersen, H. (1986), *Trends in Linguistics: Sandhi Phenomena in the Languages of Europe.* Berlin: Mouton de Gruyter.

Ashby, M., Maidment, J. (2005), *Introducing Phonetic Science.* Cambridge: Cambridge University Press.

Asher, R., E., Simpson, J., M., Y. (1994), *The Encyclopedia of Language and Linguistics.* Oxford: Pergamon Press.

Ball, M., J., Müller, N. (2005), *Phonetics for Communication Disorders.* Mahwah: Lawrence Erlbaum.

Ball, M., J., Rahilly, J. (1999), *Phonetics. The Science of Speech*. London: Edward Arnold.

Baumeister, R., F., Bushman, B., J. (2009), *Social Psychology and Human Nature.* Wadsworth: Cengage Learning.

Beaty, D. (1995), *The Naked Pilot: The Human Factor in Aircraft Accidents*. Marlborough: Airlife Publishing.

Beckman, M., E. (1986), *Stress and Non-Stress Accent.* Dordrecht: Foris Publications Holland.

Berry, D. (2002), "Donald Broadbent." *The Psychologist.* 15 (8), 402–405.

Best, C., T., Halle, P., Bohn, O., S., Faber, A. (2003), "Cross-language perception of nonnative vowels: phonological and phonetic effects of listeners' native languages." *Proceedings of the 15th International Congress of Phonetic Sciences.* 2889–2892.

Bird, B. (2005), *Engelsk fonetikk og intonasjon, innføring. ENG1103.* Oslo: Unipub AS.

Bond, Z., S., Markus, D., Stockmal., V. (2003), "Prosodic and rhythmic patterns produced by native and non-native speakers of quantity-sensitive language." *15th International Congress of Phonetic Sciences.* Barcelona, Spain 3–9 August 2003. Barcelona: UAB Press.

Bond, Z., S., Moore, T., J., Gable, B. (1996), "Listening in a second language." *Proceedings of the 4th International Conference on Spoken Language.* 2510–2513.

Borchgrevink, H., M. (1981), "Second language speech comprehension in noise: a hazard to

aviation safety." *AGARD Aural Communication in Aviation.* 5, 22–32.
British National Corpus. (2010), Available from http://www.tekstlab.uio.no/bnc/BNCquery.pl?theQuery=search&urlTest=yes [29.10.12]
Broca, P. (1865), "Sur le siège de la faculte du langage articulé." *Bulletins de la Société d'Anthropologie.* 4, 337–393.
Brown, G. (1990), *Listening to Spoken English*. London: Longman.
Chambers, F. (1997), "What do we mean by fluency?" *System.* 25 (4), 535–544.
Cleghorn, T., L., Rugg, N., M. (2011), *Comprehensive Articulatory Phonetics: a Tool for Mastering the World's Languages.* Charleston: CreateSpace Independent Publishing Platform.
Cookson, S. (2009), "Zagreb and Tenerife: airline accidents involving linguistic factors." *Australian Review of Applied Linguistics.* 32 (3), 22.1–22.14.
Coppen, P., Halteren, H., Teunissen, L. (1998), *Computational Linguistics in the Netherlands 1997.* Amsterdam: Editions Rodopi B. V.
Corpus of Contemporary American English. (2012), Available from http://corpus.byu.edu/coca/ [26.07.2012]
Couper-Kuhlen, E. (1993), *English Speech Rhythm.* Amsterdam: John Benjamins Publishing Company.
Crowley, T. (2009), *An Introduction to Historical Linguistics.* Oxford: Oxford University Press.
Crystal, D. (2003), *English as a Global Language.* Cambridge: Cambridge University Press.
Danesi, M. (2003), *Second Language Teaching. A View from the Right Side of the Brain*. London: Kluwer Academic Publishers.
DeKeyser, R. (2003), "Implicit and explicit learning." In Doughty, C., J., Long, M., H. (eds.), *The Handbook of Second Language Acquisition.* Oxford: Blackwell Publishing.
Dhillon, B., S. (2007), *Human Reliability and Error in Transportation.* London: Springer.
Dirdal, H. (2012), *The replacement of the diphthong /ʊə/.* [letter] (Personal communication, 7 September 2012).
Doughty, C., J., Long, M., H. (2008), *The Handbook of Second Language Acquisition.* Oxford: Blackwell Publishing.
Dulay, H., Burt, M. (1974), "Natural sequences in child second language acquisition." *Language Learning.* 24: 37–53.
Ellis, R. (2008), *The Study of Second Language Acquisition*. Oxford: Oxford University Press.
Endzelīns, J. (1971), *Comparative Phonology and Morphology of the Baltic Languages.* The Hague: Mouton.
Estival, D., Molesworth, B., R., C. (2009), "A study of EL2 pilots radio communication in the general aviation environment." *Australian Review of Applied Linguistics.* 32 (3), 24.1–24.16.
Felix, S. (1980), *Second Language Development: Trends and Issues.* Tübingen: Gunter Narr.
Field, J. (2003), *Psycholinguistics: a Resource Book for Students.* New York: Routledge.
Finegan, E. (2011), *Language: its Structure and Use.* Wadsworth: Cengage Learning.
Flynn, S., Martohardjono, G. (1994), "Mapping from the initial state to the final state: the separation of universal principles and language specific principles." In Lust, B., Suñer, M., Whitman, J. (eds.), *Syntactic Theory and First Language Acquisition: Cross-linguistic Perspectives.* Vol. 1.: *Heads, Projections and Learnability.* Hillsdate, NJ: Lawrence Erlbaum.
Freed, B., F. (1995), "What makes us think that students who study abroad become fluent?" In

Freed, B., F. (ed.), *Second Language Acquisition in a Study Abroad Context.* Amsterdam: John Benjamin.
Geffen, G., Quinn, K. (1984), "Hemispheric specialization and ear advantages in processing speech." *Psychological Bulletin*. 96 (2), 273–291.
Gernsbacher, M., Kaschak, M. (2003), "Neuroimaging studies of language production and comprehension." *Annual Review of Psychology*. 54, 91–114.
Giegerich, H., J. (1993), *English Phonology: an Introduction*. Cambridge: Cambridge University Press.
Gimson, A., C. (1962, 1989), *An Introduction to the Pronunciation of English*. London: Edward Arnold.
Gomez-Tortosa, E., et al. (1995), "Selective deficit of one language in a bilingual patient following surgery in the left perisylvian area." *Brain and Language*. 48, 320–325.
Gopher, D. (1992), "Analysis and measurement of mental workload." In d'Ydewalle, G., Eelen, P., Bertelson., P. (eds.), *International Perspectives on Psychological Science. Vol. 2. State of the Art.* Hillsdale, NJ: Lawrence Erlbaum Associates.
Gordon-Brannan, M., E., Weiss, C., E. (2007), *Clinical Management of Articulatory and Phonologic Disorders.* Baltimore: Lippincott Williams & Wilkins.
Gray, J. (2001), "Ch. 9: the global coursebook in English language teaching." In Cameron, D., Block, D. (eds.), *Globalization and Language Teaching.* London: Routledge.
Grigorjevs, J. (2008), *Latviešu valodas patskaņu sistēmas akustisks un auditīvs raksturojums.* Riga: LU Latviešu valodas institūts.
Grosjean, F., Deschamps, A. (1975), "Analyse contrastive des variables temporelles de l'anglais et du fransais; vitesse de parole et variables composantes, phenomenes d'hesitation." *Phonetica*. 31, 144–184.
Guasti, M., T. (2004), *Language Acquisition: the Growth of Grammar.* Cambridge: MIT Press.
Hagen, L., K. (2008), "The bilingual brain: human evolution and second language acquisition." *Evolutionary Psychology*. 6 (1), 43–63.
Hallaråker, P. (1983), *Norwegian, Nynorsk: an Introduction for Foreign Students.* Oslo: Universitetsforlaget.
Halvorsen, B. (1984), *Guide to Norwegian Pronunciation*. Bergen: Universitetet i Bergen.
Handel, S. (1989), *Listening: an Introduction to the Perception of Auditory Events*. Cambridge: MIT Press.
Hardcastle, W., J., Laver, J., Gibbon, F., E. (2010), *The Handbook of Phonetic Sciences.* Chichester: Blackwell Publishing.
Hayes, B. (1995), *Metrical Stress Theory: Principles and Case Studies.* Chicago: University of Chicago Press.
Heselwood, B., Upton, C. (2010), *Proceedings of Methods XIII.* Frankfurt: Peter Lang GnbH.
Hilton, N., H., Schuppert, A., Gooskens, C. (2011), "Syllable reduction and articulation rates in Danish, Norwegian and Swedish." *Nordic Journal of Linguistics.* 34 (2), 215–237.
Howard, J., W. (2008), "Tower, am I cleared to land? Problematic communication in aviation discourse." *Human Communication Research.* 34 (3), 370–391.
Hughes, A., Trudgill, P., Watt, D. (2005), *English Accents and Dialects.* London: Hodder Arnold.
Hulst, H. (1999), *Word Prosodic Systems in the Languages of Europe.* Berlin: Mouton de Gruyter.
Husby, O., et al. (2008), *An Introduction to Norwegian Dialects.* Trondheim: Tapir Academic

Press.
International Civil Aviation Organization (2004), *Manual on the Implementation of ICAO Language Proficiency Requirements Doc 9835 AN/453*, (First Edition): 149.
International Civil Aviation Organization, (2011), *ICAO News Release.* Available from http://www.icao.int/Newsroom/News%20Doc/PIO.21.11.EN.pdf [26.07.2012]
Jarvis, S., Pavlenko, A. (2008), *Crosslinguistic Influence in Language and Cognition*. London: Routledge.
Johansson, S., Graedler, A. (2005), "Ch. 12: anglicisms in Norwegian: when and where?" In Anderman, G., Rogers, M. (eds.), *In and Out of English. For Better, for Worse?* Clevedon: Multilingual Matters Ltd.
Katzenelenbogen, U., Manning, C., A. (1935), *The Daina: an Anthology of Lithuanian and Latvian Folk-songs.* Chicago: Lithuanian News Publishing Company.
Kaurāte, G. (2011), „Kristovska angļu valoda samulsina Klintoni." Available from http://www.tvnet.lv/zinas/arvalstis/367715kristovska_anglu_valoda_samulsina_klintoni%20-%20Kauraate%202011 [23.08.2012]
Kaurāte, G., et al. (1985), *The English Vowel Phonemes. Their Classification and Description (as Compared with Latvian Vowel Phonemes).* Riga: The Academic Press of the University of Latvia.
Kelly, L., Watson, A., K. (1989), *Speaking with Confidence and Skill.* Lanham, Maryland: University Press of America.
Kennedy, J. (2008), *Aviation English: Teacher's Book.* London: Macmillan.
Kess, J., F. (1992), *Psycholinguistics: Psychology, Linguistics, and the Study of Natural Language.* Amsterdam: John Benjamins Publishing Company.
Kewley-Port, D., Burkle, T., Z., Lee, J., H. (2007), "Contribution of consonant versus vowel information to sentence intelligibility for young normal-hearing and elderly hearinginpaired listeners." *Acoustical Society of America.* 122 (4), 2365–2375.
Kim, H., Elder, C. (2009), "Understanding aviation English as a lingua franca: perceptions of Korean aviation personell." *Australian Review of Applied Linguistics.* 32 (3), 23.1–23.17.
Kimura, D. (1961), "Cerebral dominance and the perception of verbal stimuli." *Canadian Journal of Psychology.* 15, 166–171.
Kimura, D. (1967), "Functional asymmetry of the brain in dichotic listening." *Cortex.* 3, 163–178.
Kreidler, C., W. (2004), *The Pronunciation of English*. Oxford: Blackwell Publishing.
Kreiman, J., Sidtis, D. (2011), *Foundations of Voice Studies: an Interdisciplinary Approach to Voice Production and Perception.* Oxford: Wiley-Blackwell.
Lado, R. (1957), *Linguistics Across Cultures: Applied Linguistics for Language Teachers.* Ann Arbor, Michigan: University of Michigan.
Ladefoged, P., Johnson, K. (2010), *A Course in Phonetics.* Wadsworth: Cengage Learning.
Larson-Hall, J. (2012), "How to run statistical analyses." In Mackey, A., Gass, S., M. (eds.), *Research Methods in Second Language Acquisition: a Practical Guide.* Wiley: Blackwell Publishing Ltd.
Laua, A. (1997), *Latviešu literārās valodas fonētika. 4. izd.* Riga: Zvaigzne ABC.
Lekomceva, M. [Лекомцева, М.] (2007), *Устроение языка: сборник трудов.* Moscow: OGI. [Москва: ОГИ.]
Lerdahl, F., Jackendoff, R. (1983), *A Generative Theory of Tonal Music.* Cambridge: MIT Press.
Liberman, A. (1982), *The Scandinavian Languages (Volume 1). Germanic Accentology.*

Minneapolis: the University of Minnesota Press.
Liberman, M., Y. (1975), *The intonational system of English.* Ph. D. Massachusetts Institute of Technology.
Longman Dictionary of Contemporary English. 5th ed. Harlow: Pearson Education Limited, 2009. Print.
Major, R. (2001), *Foreign Accent: the Ontogeny and Phylogeny of Second Language Phonology.* Mahwah: Lawrence Erlbaum Associates.
Mayflower College, (2012a), *Climb Level 4.* Available from http://www.climb-level4.com/ [26.07.2012]
Mayflower College, (2012b), *English for Pilots and Air Traffic Controllers: for ICAO Compliance.* Available from http://www.maycoll.co.uk/pdfs/aviation-brochure.pdf [26.07.2012]
McAllister, R., Flege, J., E., Piske, T. (2002), "The influence of L1 on the acquisition of Swedish quantity by native speakers of Spanish, English and Estonian." *Journal of Phonetics.* 30, 229–258.
Mehta, M., P. (2011), *Principles and Practice of Neuro-Oncology.* New York: Demos Medical Publishing.
Mescerjakov, B., Zincenko, V. [Мещеряков, Б., Зинченко, В.] (2004), *Большой психологический словарь.* Moscow: Olma-press. [Москва: Олма-пресс.]
Miller, F., P., Vandome, A., F., McBrewster, J. (2009), *Digraph (Ortography).* Saarbrücken: Alphascript Publishing.
Miyata, K., Miyata, C. (2006), *The Reading Edge: Using Phonics Strategically to Teach Reading.* Markham: Pembroke Publishers.
Moore, B. (1997), *An Introduction to the Psychology of Hearing*. London: Academic Press.
Morrow, D., Rodvold, M., Lee, A. (1994), "Nonroutine transactions in controller–pilot communication." *Discourse Processes.* 17, 235–258.
Motulsky, H. (2012), "QuickCalcs." Available from http://www.graphpad.com/quickcalcs/ttest1.cfm [26.07.2012]
Neimane, E. (2012), *SAS travelling to Eastern Europe.* [letter] (Personal communication, 27 Ferbuary 2012).
Neumann, O. (1996), "Theories of attention." In Neumann, O., Sanders, A. (eds.), *Handbook of Perception and Action, Volume Three: Attention*. London: Academic Press.
Nilsen, T., S. (2010), *English Pronunciation and Intonation*. Oslo: Universitetsforlaget.
Odlin, T. (1989), *Language Transfer: Cross-linguistic Influence in Language Learning.* Cambridge: Cambridge University Press.
Oliveira, M. (2002), "The role of pause occurrence and pause duration in the signaling of narrative structure." In Ranchhod, E., Mamede, N., J. (eds.), *Advances in Natural Language Processing.* Berlin: Springer.
Owren, M., J., Cardillo, G., C. (2006), "The relative roles of vowels and consonants in discriminating talker identity versus word meaning." *Acoustical Society of America.* 119 (3), 1727–1739.
Oxford English Dictionary. 20th ed. Oxford: Oxford University Press, 2011. Print.
Paukšte, Z. (2012), *The speaking rate of Latvian.* [letter] (Personal communication, 18 January 2012).
Popperwell, R., G. (2010), *The Pronunciation of Norwegian.* Cambridge: Cambridge University Press.

Price, C., Green, D., Von Studnitz, R. (1999), "Functional imaging study of translation and language switching." *Brain*. 122, 2221–2236.
Raupach, M. (1980), "Temporal variables in first and second language speech production." In Dechert, H., W., Raupach, M. (eds.), *Temporal Variables in Speech*. The Hague: Mouton.
Raupach, M. (1987), "Procedural learning in advanced learners of a foreign language." In Coleman, J., A., Towell, R. (eds.), *The Advanced Language Learner*. London: CILT.
Read, J., Knoch, U. (2009), "Clearing the air: applied linguistic perspectives on aviation communication." *Australian Review of Applied Linguistics*. 32 (3), 21.1–21.11.
Reynolds, C., R., Fletcher-Janzen, E. (2004), *Concise Encyclopedia of Special Education: a Reference for the Education of the Handicapped and Other Exceptional Children and Adults*. Hoboken: John Wiley & Sons, Inc.
Ringbom, H. (1987), *The Role of the First Language in Foreign Language Learning*. Clevedon: Multilingual Matters.
Ringbom, H. (2007), *Cross-linguistic Similarity in Foreign Language Learning*. Clevedon: Multilingual Matters.
Roach, P. (2009), *English Phonetics and Phonology: a Practical Course*. Cambridge: Cambridge University Press.
Robinson, P. (2003), "Attention and memory during SLA." In Doughty, C., J., Long, M., H. (eds.), *The Handbook of Second Language Acquisition*. Oxford: Blackwell Publishing.
Roitsch, P. A., Babcock, G. L., Edmunds, W. W. (1978), *Human Factors Report on the Tenerife Accident*. Washington: Air Line Pilots Association.
Rozenbergs, J. (1969), *Latviešu un krievu valodas fonēmu salīdzinājums*. Riga: The Academic Press of the University of Latvia.
Runchhod, E., Mamede, N., J. (2002), *Advances in Natural Language Processing*. London: Springer.
Ryalls, J. (1996), *A Basic Introduction to Speech Perception*. San Diego: Singular Pub. Group.
Sanders, D. A. (1977), *Auditory Perception of Speech: an Introduction to Principles and Problems*. Englewood Cliffs, NJ: Prentice-Hall.
Schmidt, R., A., Lee, T., D. (2011), *Motor Control and Learning*. Leeds: Human Kinetics.
Sequeira, S. (2008), *The Effects of Background Noise on Asymmetrical Speech Perception*. Ph.D. University of Bergen.
Setton, R. (1999), *Simultaneous Interpretation: a Cognitive-pragmatic Analysis*. Amsterdam: John Benjamins Publishing Co.
Sinkova, O. (2010), *Teaching Listening Skills to Pilots One-to-one*. Bachelor thesis. University of Latvia.
Skandera, P., Burleigh, P. (2011), *A Manual of English Phonetics and Phonology*. Mössingen: Narr Verlag.
Sperry, R., W. (1964), "The great cerebral commissure." *Scientific American*. 210 (1), 42–52.
Steinbergs, A. (2010), "The Latvian alphabet." Available from http://www.latvianstuff.com/Alphabet.html [25.08.12]
Stenbrenden, G., F. (2012), *The replacement of the /ʊə/ by the /ɔ:/*. [letter] (Personal communication, 19 October 2012).
Stenbrenden, G., F. (2012), *An alternative RP pronunciation of the word 'year'*. [letter] (Personal communication, 30 October 2012).
Stevens, P. (2011), *The use of RP for practical reasons*. [letter] (Personal communication, 6 February 2012).

Stilp, C., E., Kluender, K., R. (2010), "Cochlea-scaled entropy, not consonants, vowels, or time, best predicts speech intelligibility." *Proceedings of the National Academy of Sciences of the United States of America.* 107 (27), 12387–12392.
Stoddart, J. (1858), *Glossology: or, the Historical Relations of Languages.* Glasgow: Richard Griffin and Company, Publishers of the University of Glasgow.
Studdert-Kennedy, M., Shankweiler, D. P. (1970), "Hemispheric specialization of speech perception." *Journal of the Acoustical Society of America.* 48, 579–594.
Suchert, A. (2004), "The neurobiology of attention." In Schumann, J., Crowell, S., Jones, N., Lee, N., Shuchert, S., Wood, L. (eds.), *The Neurobiology of Learning: Perspectives from Second Language Acquisition.* Mahwah, N.J.: Lawrence Erlbaum.
The Latvian Language Institute, (the Latvian language consultants from the Latvian Language Institute), (2012), *Empirical results on pausing patterns and speed of Modern Latvian.* [letter] (Personal communication, 17 January 2012).
Torkildsen, J. (2002), *Functional Lateralization of the Processing of Intonation in Norwegian – a Dichotic Listening Experiment.* Term Paper in SLI 300. University of Oslo.
Towell, R. (1987), "Approaches to the analysis of the oral language development of the advanced learner." In Coleman, J., A., Towell, R. (eds.), *The Advanced Language Learner.* London: CILT.
Towell, R., Hawkins, R., Bazergui, N. (1996), "The development of fluency in advanced learners of French." *Applied Linguistics.* 17, 84–119.
Trubeckoj, N., S. (1939), *Grundzyge der Phonologie.* Prague: Le Cercle.
Trubeckoj, N., S. (1958), *Anleitung zu Phonologischen Beschreibungen.* Göttingen: Vandenhoeck & Ruprecht.
Tsao, Y., Weismer, G. (1997), "Interspeaker variation in habitual speaking rate: evidence for a neuromuscular component." *Journal of Speech, Language, and Hearing Research.* 40, 858–866.
Vanvik, A. (1975), *English Phonetics for Norwegian Students*. Oslo: Universitetsforlaget.
Vanvik, A. (1983), *Kort Innføring i Fonetikk*. Oslo: Universitetsforlaget.
Vygotsky, L. (1978), *Mind in Society.* Cambridge, MA: Harvard University Press.
Wells, J., C. (2006), *English Intonation: an Introduction.* Cambridge: Cambridge University Press.
Wells, J., C., Colson, G. (1971), *Practical Phonetics*. London: Pitman Publishing.
Wernicke, C. (1874), *Der Aphasische Symptomenkomplex: eine Psychologische Studie auf Anatomischer Basis.* Wroclaw: Cohn and Weigert. (G. H. Eggert, Trans.) In *Wernicke's Works on Aphasia: a Sourcebook and Review.* The Hague: Mouton, 1977.
Wickens, C., Gordon, S., E., Liu, Y. (1997), *An Introduction to Human Factors Engineering.* New York: Longman.
Wood, D. (2001), "In search of fluency: what is it and how can we teach it?" *The Canadian Modern Language Review.* 57 (4), 573–589.
Yudofsky, S., C., Hales, R., E. (2008), *Textbook of Neuropsychiatry and Behavioral Neurosciences.* Arlington: American Psychiatric Publishing.
Zilles, K., et al. (1996), "Structural asymmetries in the human forebrain of non-human primates and rats." Neurosci Biobehav Rev. 20 (4), 593–605.
Zybatow, L., N. (2010), *Translationswissenschaft – Stand und Perspektiven.* Frankfurt: Peter Lang GmbH.
Žiūkaitė-Hansen, L. (2005), *Beginner's Norwegian.* New York: George Blagowidow.

Appendices

Appendix 1

English, Latvian and Norwegian consonant phoneme classifications

	Bilabial	Labio-dental	(apico-) Dental	(apico-) Alveolar	Post-alveolar	Palatal	Velar	Glottal
Plosives	p b			t d			k g	
Affricates					tʃ dʒ			
Fricatives		f v	θ ð	s z	ʃ ʒ			h
Nasals	m			n			ŋ	
Lateral				l				
Open approximants	w				r	j	w	

Figure 1: **English consonant phoneme classification, RP (Bird, 2005: 20)**

	Bilabial	Labio-dental	Dental	Alveolar	Palatal	Velar
Plosives	p b		t d		ķ ģ	k g
Affricates			c ʒ	č	č* *	
Nasals	m		n		ņ	ŋ
Medials		f v	s z	š ž r	j š* ž*	x
Lateral				l	ļ	

Figure 2: **Latvian consonant phoneme classification (Laua, 1997: 63)**

	Bilabial	Labio-dental	Dental (or: lamino-alveolar)	Alveolar	Post-alveolar	Palatal	Velar	Glottal
Plosives	p b		t d				k g	
Fricatives		f		s	ʃ	ç		h
Nasals	m		n				ŋ	
Lateral			l					
Tap				r				
Open approximants		ʊ				j		

Figure3: **Eastern Norwegian consonant phoneme classification (Bird, 2005: 21)**

Appendix 2

The difference between the number of phonological and phonetic syllables counted in a radio news broadcast (NRK) and in a set of semantically unpredictable sentences

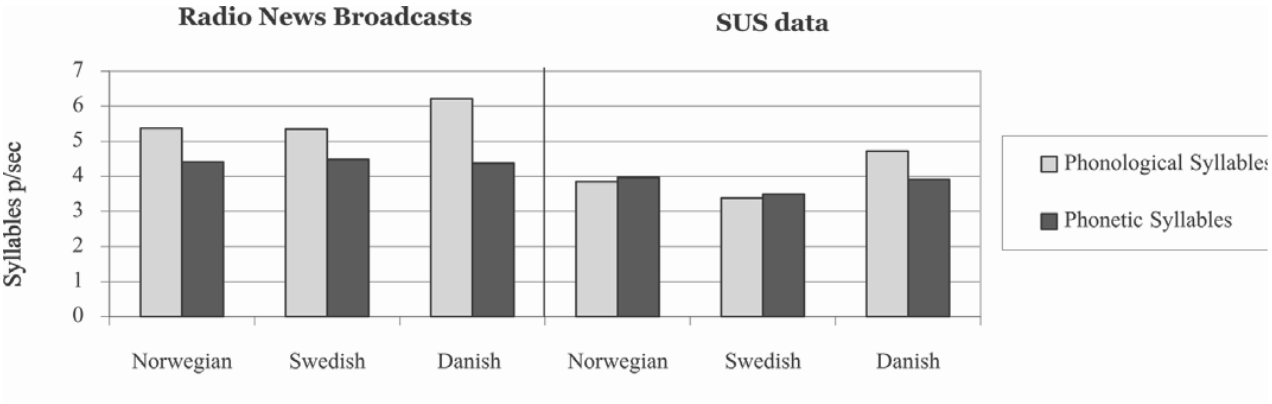


Figure 4: **Difference (reduction) in articulation rates of phonological and phonetic syllables in the two data set (Hilton *et al*., 2011: 228)**

Appendix 3

ICAO language proficiency rating scale

LEVEL	PRONUNCIATION *Assumes a dialect and/or accent intelligible to the aeronautical community.*	STRUCTURE *Relevant grammatical structures and sentence patterns are determined by language functions appropriate to the task.*	VOCABULARY	FLUENCY	COMPREHENSION	INTERACTIONS
Expert 6	Pronunciation, stress, rhythm, and intonation, though possibly influenced by the first language or regional variation, almost never interfere with ease of understanding.	Both basic and complex grammatical structures and sentence patterns are consistently well controlled.	Vocabulary range and accuracy are sufficient to communicate effectively on a wide variety of familiar and unfamiliar topics. Vocabulary is idiomatic, nuanced, and sensitive to register.	Able to speak at length with a natural, effortless flow. Varies speech flow for stylistic effect, e.g. to emphasize a point. Uses appropriate discourse markers and connectors spontaneously.	Comprehension is consistently accurate in nearly all contexts and includes comprehension of linguistic and cultural subtleties.	Interacts with ease in nearly all situations. Is sensitive to verbal and non-verbal cues and responds to them appropriately.
Extended 5	Pronunciation, stress, rhythm, and intonation, though influenced by the first language or regional variation, rarely interfere with ease of understanding.	Basic grammatical structures and sentence patterns are consistently well controlled. Complex structures are attempted but with errors which sometimes interfere with meaning.	Vocabulary range and accuracy are sufficient to communicate effectively on common, concrete, and work-related topics. Paraphrases consistently and successfully. Vocabulary is sometimes idiomatic.	Able to speak at length with relative ease on familiar topics but may not vary speech flow as a stylistic device. Can make use of appropriate discourse markers or connectors.	Comprehension is accurate on common, concrete, and work-related topics and mostly accurate when the speaker is confronted with a linguistic or situational complication or an unexpected turn of events. Is able to comprehend a range of speech varieties (dialect and/or accent) or registers.	Responses are immediate, appropriate, and informative. Manages the speaker/listener relationship effectively.
Operational 4	Pronunciation, stress, rhythm, and intonation are influenced by the first language or regional variation but only sometimes interfere with ease of understanding.	Basic grammatical structures and sentence patterns are used creatively and are usually well controlled. Errors may occur, particularly in unusual or unexpected circumstances, but rarely interfere with meaning.	Vocabulary range and accuracy are usually sufficient to communicate effectively on common, concrete, and work-related topics. Can often paraphrase successfully when lacking vocabulary in unusual or unexpected circumstances.	Produces stretches of language at an appropriate tempo. There may be occasional loss of fluency on transition from rehearsed or formulaic speech to spontaneous interaction, but this does not prevent effective communication. Can make limited use of discourse markers or connectors. Fillers are not distracting.	Comprehension is mostly accurate on common, concrete, and work-related topics when the accent or variety used is sufficiently intelligible for an international community of users. When the speaker is confronted with a linguistic or situational complication or an unexpected turn of events, comprehension may be slower or require clarification strategies.	Responses are usually immediate, appropriate, and informative. Initiates and maintains exchanges even when dealing with an unexpected turn of events. Deals adequately with apparent misunderstandings by checking, confirming, or clarifying.
Pre-operational 3	Pronunciation, stress, rhythm, and intonation are influenced by the first language or regional variation and frequently interfere with ease of understanding.	Basic grammatical structures and sentence patterns associated with predictable situations are not always well controlled. Errors frequently interfere with meaning.	Vocabulary range and accuracy are often sufficient to communicate on common, concrete, or work-related topics, but range is limited and the word choice often inappropriate. Is often unable to paraphrase successfully when lacking vocabulary.	Produces stretches of language, but phrasing and pausing are often inappropriate. Hesitations or slowness in language processing may prevent effective communication. Fillers are sometimes distracting.	Comprehension is often accurate on common, concrete, and work-related topics when the accent or variety used is sufficiently intelligible for an international community of users. May fail to understand a linguistic or situational complication or an unexpected turn of events.	Responses are sometimes immediate, appropriate, and informative. Can initiate and maintain exchanges with reasonable ease on familiar topics and in predictable situations. Generally inadequate when dealing with an unexpected turn of events.
Elementary 2	Pronunciation, stress, rhythm, and intonation are heavily influenced by the first language or regional variation and usually interfere with ease of understanding.	Shows only limited control of a few simple memorized grammatical structures and sentence patterns.	Limited vocabulary range consisting only of isolated words and memorized phrases.	Can produce very short, isolated, memorized utterances with frequent pausing and a distracting use of fillers to search for expressions and to articulate less familiar words.	Comprehension is limited to isolated, memorized phrases when they are carefully and slowly articulated.	Response time is slow and often inappropriate. Interaction is limited to simple routine exchanges.
Pre-elementary 1	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.

Note.— The Operational Level (Level 4) is the minimum required proficiency level for radiotelephony communication. Levels 1 through 3 describe Pre-elementary, Elementary, and Pre-operational levels of language proficiency, respectively, all of which describe a level of proficiency below the ICAO language proficiency requirement. Levels 5 and 6 describe Extended and Expert levels, at levels of proficiency more advanced than the minimum required Standard. As a whole, the scale will serve as benchmarks for training and testing, and in assisting candidates to attain the ICAO Operational Level (Level 4).

Figure 5: **ICAO Rating Scale (ICAO, Manual on the Implementation of ICAO Language Proficiency Requirements, Doc 9835 AN/453, 2004: A-8–A-9)**

Appendix 4

Abnormal requesting diversion to an alternative airport due to lack of fuel

(9) **p:** Incheon Control, Cathay 883

(10) **c:** *Yes,* go ahead

(11) **p:** Roger *sir,* due to *operational requirement we're having to divert and diversion port will be Shanghai. If you could er… liaise with Shanghai ATC and* request **vector** *for landing in Shanghai, please,* Cathay 883

(12) **c:** Cathay 883, *copy that*

vectoring is provision of navigational guidance to aircraft in the form of specific headings, based on the use of an air traffic service surveillance system.

(13) **c:** Cathay 883, *let me know why er… divert to Shanghai airport?*

(14) **p:** Cathay 883, due to *strong head wind, we do not have enough fuel to reach Hong Kong, weather in Taipei is not suitable for landing. Our company would like us to go to Shanghai to refuel,* Cathay 883

(15) **c:** Roger, due to weather, destination *yeah…,* Hong Kong airport?

(16) **p:** Negative, due to *strong head wind and not enough fuel to reach Hong Kong,* Cathay 883

(17) **c:** *Okay, copy that*

(18) **c:** Cathay 883, confirm your destination, Pudong airport or *any other* airport?

(19) **p:** Cathay 883, go ahead

(20) **c:** Cathay 883, confirm your destination, Pudong airport or *other* airport?

(21) **p:** Cathay 883, er… *from company we'd like to change plan, we are… now require diversion to Kansai. We need you can organize that we'll turn around and go to Kansai,* Cathay 883

(22) **c:** Cathay 883, *okay,* confirm er… verify destination Hongqiao or Pudong?

(23) **p:** Destination now Kansai in Japanese airspace, Kansai, **RJBB**, Cathay 883

RJBB is the four-letter code of Kansai airport in Osaka.

(24) **c:** Confirm destination, Kansai?

(25) **p:** Affirmative, *sorry we've got to change. It is Kansai,* Cathay 883

(26) **c:** Roger, *you change* destination, Kansai, standby clearance

(27) **p:** Standby clearance Kansai, Cathay 883

(28) **c:** Cathay 883, cleared to Kansai airport, RJBB airport, and present position direct **RUGMA,** RUGMA, *and then … er…* maintain flight level 360

RUGMA is the name of a fix. A fix is a navigational position.

(29) **p:** Cleared to Kansai, present position direct to RUGMA, *We need to spell er… the* ***waypoint*** *RUGMA,* Cathay 883

Waypoint is another name for a fix.

(30) **c:** Cathay 883, turn left heading, turn left heading 190

(31) **p:** Left heading 190 and confirm the waypoint RUGMA, *how to spell,* Cathay 883

(32) **c:** Affirmative, clear direct RUGMA

(33) **p:** Confirm *the spelling for RUGMA, how to spell,* Cathay 883

(34) **c:** Cathay 883, affirmative, cleared direct RUGMA er… Romeo Uniform Mike, correction, Romeo Uniform Golf Mike Alfa

(35) **p:** Direct RUGMA, Cathay 883, proceeding direct to RUGMA, maintaining level 360

Source: Kim and Elder, 2009: 23.8–23.11

Appendix 5, **Questionnaire**

Dear respondent,

Please fill in the following questionnaire, ticking (✓), circling or filling in the gaps where required. Your contribution will help me in conducting research on investigating problems Latvian and Norwegian airline transport pilots face when perceiving speech of their native-speaking colleagues. The questionnaire is anonymous and will be used only for research purposes.

Please provide general information about yourself:

- Age: _____
- Years of professional experience:_____
- Gender: ☐ Male
  ☐ Female

1. How many years have you been studying English? _____
2. Have you lived in English-speaking countries? Yes ☐
   No ☐
3. Have you had English as a language of instruction while studying? Yes ☐
   No ☐
4. How often do you use English in your everyday life?
   ☐ Every day
   ☐ Several times a week
   ☐ Several times a month
   ☐ Less often
5. What is your proficiency level in English?
   ☐ Operational level 4
   ☐ Extended level 5
   ☐ Expert level 6
6. Please evaluate your listening skills:
   ☐ Unsatisfactory
   ☐ Satisfactory
   ☐ Medium
   ☐ Good

Study Materials

1. What study materials did you use to achieve ICAO Level 4?

_____

Evaluation

1. Please evaluate several aspects of the English teaching programme for preparation for ICAO examination you have had (A = excellent, B = good, C = acceptable, D = poor):
   - Listening activities: A – B – C – D
   - Information on English phonetics: A – B – C – D

2. Please evaluate whether ICAO examination on English language proficiency conducted in Latvia/Norway truly reflects pilots' proficiency level in:
   - Listening to standard phraseology: A – B – C – D
   - Listening to plain language used in emergency situations: A – B – C – D
   - Listening to native speakers: A – B – C – D
   - Listening to non-native speakers: A – B – C – D

Changes

1. Would you like to introduce any changes to the teaching programme for preparation for ICAO examination (which you have had):

   ☐ Yes

   ☐ No

   Comments: _____

You are welcome to write your comments and suggestions:

_____

_____

Thank you for your cooperation!

Appendix 6

Tests

Tests pārbauda angļu valodas runas uztveri. Testa mērķis ir identificēt runas uztveres problēmas, kas rodas latviešu pilotiem, kad tie komunicē ar kolēģiem, kuriem dzimtā valoda ir angļu.

Testa ilgums ir 20 minūtes.
Tests sastāv no 3 uzdevumiem.

1. Uzdevums

Lūdzu, noklausieties vienu un to pašu vārdu izrunātu dažādos variantos un atzīmējiet pareizo variantu. Jums ir iespēja izmēģināt.

Izmēģinājumam:

- Journey (*brauciens, ceļojums pa sauszemi*) 1) ____ 2) ____ 3) ____

Uzdevums:

1. Learn (*mācīties*) 1) ____ 2) ____ 3) ____
2. Subject (*subjekts*) 1) ____ 2) ____ 3) ____
3. Manoeuvre (*manevrs*) 1) ____ 2) ____ 3) ____
4. Gear (*mehānisms, iekārta*) 1) ____ 2) ____ 3) ____
5. Where (*kur*) 1) ____ 2) ____ 3) ____ 4) ____
6. Europe (*Eiropa*) 1) ____ 2) ____ 3) ____
7. Problem (*problēma*) 1) ____ 2) ____
8. Start (*uzsākt*) 1) ____ 2) ____
9. Perfect (*perfekts*) 1) ____ 2) ____ 3) ____
10. Productive (*produktīvs*) 1) ____ 2) ____ 3) ____
11. Suffer (*ciest*) 1) ____ 2) ____ 3) ____
12. Year (*gads*) 1) ____ 2) ____ 3) ____
13. There (*tur*) 1) ____ 2) ____ 3) ____ 4) ____
14. Secure (drošs) 1) ____ 2) ____ 3) ____
15. Hot (*karsts*) 1) ____ 2) ____
16. After (*pēc*) 1) ____ 2) ____

17. First (*pirmais*) 1) ____ 2) ____ 3) ____

18. Upgrade (*uzlabojums*/*jauninājums*) 1) ____ 2) ____ 3) ____

19. Beginner (*iesācējs*) 1) ____ 2) ____ 3) ____

20. Here (*šeit*) 1) ____ 2) ____ 3) ____

21. Aircraft (*lidmašīna*) 1) ____ 2) ____ 3) ____ 4) ____

22. Plural (*daudzskaitlis*) 1) ____ 2) ____ 3) ____

23. Top (*virsotne*) 1) ____ 2) ____

24. Largely (*lielā mērā*/*galvenokārt*) 1) ____ 2) ____

2. Uzdevums

Lūdzu, ierakstiet atbilstošā lodziņā vienu no diviem vārdiem, kas tiks izrunāti teikumos. Jums ir iespēja izmēģināt pirmo teikumu.

Izmēģinājumam:

❖ **Cut** (*elektroenerģijas padeves pārtraukšana*) vai **Cat** (*kaķis*)

They were worried about the _____.

Uzdevums:

- **Pen** (*pildspalva*) vai **Pin** (*adata*)

1. One of the passengers found a **_____** on the floor.

- **Pet** (*iemīļots dzīvnieks*) vai **Pat** (*viegls uzsitiens*)

2. He gave me a _____.

- **Cup** (*tasīte*) vai **Cap** (*cepure*)

3. He wanted to buy a _____.

- **Luck** (*veiksme*) vai **Lock** (*slēdzene*)

4. It went well because of his **_____**.

- **Omission** (*izlaidums, nolaidība*) vai **Emission** (*izplūde, izmete*)

5. There is a serious _____.

- **Cool down** (*nomierināt*) vai **Call down** (*nopulgot*)

6. Shall I **_____** them **down**?

- **Pier** (*dambis*) vai **Pear** (*bumbieris*)

7. He bought a painting of a **_____**.

- **Hoses** (*šļūtenes*) vai **Houses** (*mājas*)

8. Are these your **_____**?

- **Try** (*mēģinājums*) vai **Tray** (*paplāte*)

9. It was a nice **_____**.

- **Bitter** (*rūgts*) vai **Better** (*labāk*)

10. I feel **_____** about my plan.

- **Tech** (*tehnika*) vai **Tack** (*nagla ar platu galviņu*)

11. We need a new **_____**.

- **Truck** (*kravas automašīna*) vai **Track** (*pēdas*)

12. There was a small **_____** going up to the cabin.

- **Nut** (*uzgrieznis*) vai **Knot** (*mezgls*)

13. I'm struggling to loosen this tight **_____**.

- **Addition** (*pielikums, papildinājums*) vai **Edition** (*izdevums*)

14. They promised there would be a new _____.

- **Food** (*barība*, *ēdiens*) vai **Ford** (*brasls*)

15. He forgot about the **_____**.

- **Here** (*šeit*) vai **Hair** (*mati*)

16. I can't see her **_____**.

- **No** (*nē*) vai **Now** (*tagad*)

17. **_____**(,) he didn't turn.

- **Light** (*viegls*) vai **Late** (*vēls*)

18. They thought it was very **_____**.

- **Litter** (*izsvaidītas lietas*, *izmētāti papīri*) vai **Letter** (*vēstule*)

19. Where is your **_____**?

- **Ex** (*bijusī sieva*/*vīrs*) vai **Axe** (*cirvis*)

20. His _____ was in the living room.

- **Bug** (*kukainis*; *vabole*) vai **Bag** (*soma*)

21. There is a _____ on the table.

- **Duck** (*pīle*) vai **Dock** (*doks*)

22. They were aiming for the _____.

- **Allusion** (*atsaukšanās uz kaut ko vai kādu*) vai **Illusion** (*ilūzija*)

23. There is no point in your **_____**.

- **Fool** (*muļķis*) vai **Fall** (*rudens*)

24. This _____ is making me sad.

- **Beer** (*alus*) vai **Bear** (*lācis*)

25. This _____ is from Norway.

- **Clone** (*klons*) vai **Clown** (*klauns*)

26. Don't look like a **_____**!

- **Mile** (*jūdze*) vai **Mail** (*pasts*)

27. What about your last **_____**?

3. Uzdevums

Lūdzu, noklausieties vienu no diviem uzrakstītajiem vārdiem un atzīmējiet to testā. Jums ir iespēja izmēģināt.

Izmēģinājumam:

❖ **Bed** (*gulta*) _____ vai **Bad** (*slikts*) _____

1. **Bit** (*gabaliņš, druska*) _____ vai **Bet** (*derības*) _____
2. **Bet** (*derības*) _____ vai **Bat** (*sikspārnis*) _____
3. **Luck** (*veiksme*) _____ vai **Lack** (*trūkums, nepietiekamība*) _____
4. **Fund** (*krājums*) _____ vai **Fond** (*mīlošs, maigs*) _____
5. **Accept** (*pieņemt*) _____ vai **Except** (*izņemot*) _____
6. **Tool** (*darbarīks*) _____ vai **Tall** (*garš*) _____
7. **Tier** (*kārta*) _____ vai **Tear** (*plīsums, caurums*) _____
8. **Tone** (*tonis*) _____ vai **Town** (*pilsēta*) _____
9. **Pay** (*samaksa*) _____ vai **Pie** (pīrāgs) _____
10. **Sit** (*sēdēt*) _____ vai **Set** (*komplekts, kolekcija*) _____
11. **Pen** (*pildspalva*) _____ vai **Pan** (*panna*) _____
12. **Lug** (*rokturis*, tehn. *austiņa*) _____ vai **Lag** (*atpalikšana, kavēšanās*) _____
13. **Dull** (*truls, neass*) _____ vai **Doll** (*lelle*) _____
14. **Affect** (*ietekmēt*) _____ vai **Effect** (*realizēt, izpildīt*) _____
15. **Sue** (*iesūdzēt tiesā*) _____ vai **Saw** (*zāģēt*) _____
16. **We're** (*mēs esam*) _____ vai **Where** (*kur*) _____
17. **Crone** (*vecene*; *krona*) _____ vai **Crown** (*kronis*; *vainags*) _____
18. **Die** (*mirt*) _____ vai **Day** (*diena*) _____

Liels paldies par sadarbību!!! ☺

Test

Denne testen undersøker taleoppfattelse på engelsk. Hensikten med testen er å identifisere eventuelle problemer norske piloter har med å oppfatte tale av kollegaer som har engelsk som morsmål.

Testen varer ca. 20 minutter.
Testen inneholder 3 deler.

Del 1

I denne delen vil du få høre en rekke ord. Hvert ord er uttalt på ulike måter. Kryss av for den uttalen du mener er korrekt. Først vil du få høre et eksempel du kan øve deg på.

Eksempel:

❖ Journey (*ferd, reise*) 1) ____ 2) ____ 3) ____

1) Learn (*lære*) 1) ____ 2) ____ 3) ____
2) Subject (*subjekt, tema*) 1) ____ 2) ____ 3) ____
3) Manoeuvre (*manøvrering*) 1) ____ 2) ____ 3) ____
4) Gear (*gir*) 1) ____ 2) ____ 3) ____
5) Where (*hvor*) 1) ____ 2) ____ 3) ____ 4) ____
6) Europe (*Europa*) 1) ____ 2) ____ 3) ____
7) Problem (*problem*) 1) ____ 2) ____
8) Start (*begynne, starte*) 1) ____ 2) ____
9) Perfect (*perfekt*) 1) ____ 2) ____ 3) ____
10) Productive (*produktiv*) 1) ____ 2) ____ 3) ____
11) Suffer (*lide*) 1) ____ 2) ____ 3) ____
12) Year (*år*) 1) ____ 2) ____ 3) ____
13) There (*der*) 1) ____ 2) ____ 3) ____ 4) ____
14) Secure (*trygg*) 1) ____ 2) ____ 3) ____
15) Hot (*varm*) 1) ____ 2) ____
16) After (*etter*) 1) ____ 2) ____
17) First (*først(e)*) 1) ____ 2) ____ 3) ____

18) Upgrade (*oppgradere*) 1) ____ 2) ____ 3) ____

19) Beginner (*nybegynner*) 1) ____ 2) ____ 3) ____

20) Here (*her*) 1) ____ 2) ____ 3) ____

21) Aircraft (*luftfartøy*) 1) ____ 2) ____ 3) ____ 4) ____

22) Plural (*flertall*) 1) ____ 2) ____ 3) ____

23) Top (*top*) 1) ____ 2) ____

24) Largely (*i stor grad*) 1) ____ 2) ____

Del 2

I denne delen får du høre en setning som inneholder ett av de to ordene som er oppgitt. Fyll ut det ordet du hører. Det kan øve på det første eksemplet.

Eksempel:

❖ **Cut** (kutt) vs. **Cat** (*katt*)

They were worried about the _____.

- **Pen** (*penn*) vs. **Pin** (*nål*)

1) One of the passengers found a **_____** on the floor.

- **Pet** (*kjæledyr*) vs. **Pat** (*klapp*)

2) He gave me a _____.

- **Cup** (*kopp*) vs. **Cap** (*lue*)

3) He wanted to buy a _____.

- **Luck** (*hell*) vs. **Lock** (*lås*)

4) It went well because of his **_____**.

- **Omission** (*utelatelse*) vs. **Emission** (*utslipp*)

5) There is a serious _____.

- **Cool down** (*kjøle ned*) vs. **Call down** (*rope på (slik at de kommer ned)*)

6) Shall I **_____** them **down**?

- **Pier** (*landgangsbrygge, pir*) vs. **Pear** (*pære*)

  7) He bought a painting of a **_____**.

- **Hoses** (*vannslanger*) vs. **Houses** (*hus*)

  8) Are these your **_____**?

- **Try** (*forsøk*) vs. **Tray** (*brett*)

  9) It was a nice **_____**.

- **Bitter** (*bitter*) vs. **Better** (*bedre*)

  10) I feel **_____** about my plan.

- **Tech** (*teknologi* (forkortelse)) vs. **Tack** (*stift*)

  11) We need a new **_____**.

- **Truck** (*lastebil*) vs. **Track** (*spor*)

  12) There was a small **_____** going up to the cabin.

- **Nut** (*mutter*) vs. **Knot** (*knute*)

  13) I'm struggling to loosen this tight **_____**.

- **Addition** (*tillegg*) vs. **Edition** (*utgave*)

  14) They promised there would be a new _____.

- **Food** (*mat*) vs. **Ford** (*vadested*)

  15) He forgot about the **_____**.

- **Here** (*her*) vs. **Hair** (*hår*)

  16) I can't see her **_____**.

- **No** (*nei*) vs. **Now** (*nå*)

  17) **_____**(,) he didn't turn.

- **Light** (*lys, lett*) vs. **Late** (*seint*)

  18) They thought it was very **_____**.

- **Litter** (*avfall*) vs. **Letter** (*brev*)

  19) Where is your **_____**?

- **Ex** (*ekskjæreste*) vs. **Axe** (*øks*)

  20) His **_____** was in the living room.

- **Bug** (*insekt*) vs. **Bag** (*veske*)

  21) There is a **_____** on the table.

- **Duck** (*and*) vs. **Dock** (*havn*)

  22) They were aiming for the **_____**.

- **Allusion** (*allusjon, referanse*) vs. **Illusion** (*illusjon*)

  23) There is no point in your _____.

- **Fool** (*idiot, tosk*) vs. **Fall** (*høst*)

  24) This _____ is making me sad.

- **Beer** (*øl*) vs. **Bear** (*bjørn*)

  25) This _____ is from Norway.

- **Clone** (*kloning, kopi*) vs. **Clown** (*klovn*)

  26) Don't look like a _____!

- **Mile** (*mil*) vs. **Mail** (*post*)

  27) What about your last _____?

Del 3

I del 3 får du høre ett av de to ordene som er oppgitt i hvert par nedenfor. Kryss av for det ordet du hører. Igjen får du et eksempel for øvelse først.

Eksempel:

❖ **Bed** (*seng*) _____ vs. **Bad** (*dårlig*) _____

1. **Bit** (*bit, stykke*) _____ vs. **Bet** (*vedde*) _____
2. **Bet** (*vedde*) _____ vs. **Bat** (*flaggermus*) _____
3. **Luck** (*lykke, hell*) _____ vs. **Lack** (*mangel*) _____
4. **Fund** (*fond*) _____ vs. **Fond** (*øm, kjærlighetsfull*) _____
5. **Accept** (*akseptere, ta imot*) _____ vs. **Except** (*unnta, unntatt*) _____
6. **Tool** (*instrument, verktøy*) _____ vs. **Tall** (*høy*) _____
7. **Tier** (*rad*) _____ vs. **Tear** (*slite, rive*) _____
8. **Tone** (*tone*) _____ vs. **Town** (*by*) _____
9. **Pay** (*betale*) _____ vs. **Pie** (*pai*) _____
10. **Sit** (*sitte*) _____ vs. **Set** (*sette*) _____
11. **Pen** (*penn*) _____ vs. **Pan** (*panne*) _____
12. **Lug** (*slepe, hale*) _____ vs. **Lag** (*forsinkelse*) _____
13. **Dull** (*matt, kjedelig*) _____ vs. **Doll** (*dokke*) _____
14. **Affect** (*berøre, påvirke*) _____ vs. **Effect** (*effekt*) _____
15. **Sue** (*saksøke*) _____ vs. **Saw** (*sage*) _____
16. **We're** (*vi er*) _____ vs. **Where** (*hvor*) _____
17. **Crone** (*gammel kjerring*) _____ vs. **Crown** (*krone*) _____
18. **Die** (*dø*) _____ vs. **Day** (*dag*) _____

Takk for hjelpen!!! ☺

Tests

Tests pārbauda angļu valodas runas uztveri. Testa mērķis ir identificēt runas uztveres problēmas kas rodas latviešu pilotiem kad tie komunicē ar kolēģiem kuriem dzimtā valoda ir angļu.

Testa ilgums ir 20 minūtes.
Tests sastāv no 3 uzdevumiem.

4. Uzdevums

Lūdzu, noklausieties vienu un to pašu vārdu izrunāto dažādos variantos un atzīmējiet pareizo variantu. Jums ir iespēja izmēģināt.

Izmēģinājumam

❖ Journey 1) /ˈdʒ**æ:**.ni/ 2) /ˈdʒ**ɜ:**.ni/ 3) /ˈdʒ**ø:**.ni/

Uzdevums:

1. Learn 1) /l**ɜ:**n/ 2) /l**æ:**n/ 3) /l**ø:**n/
2. Subject 1) /ˈs**a**b.dʒekt/ 2) /ˈs**ø**b.dʒekt/ 3) /ˈsʌb.dʒekt/
3. Manoeuvre 1) /m**e**ˈnuː.və/ 2) /m**æ**ˈnuː.və/ 3) /m**ə**ˈnuː.və/
4. Gear 1) /g**ɪə**/ 2) /g**iə**/ 3) /g**eə**/
5. Where 1) /w**æə**/ 2) /w**æ:ə**/ 3) /w**e:ə**/ 4) /w**eə**/
6. Europe 1) /ˈj**uo**.rəp/ 2) /ˈj**ʊə**.rəp/ 3) /ˈj**ʉ**.rəp/
7. Problem 1) /ˈprɒb.ləm/ 2) /ˈprɔb.ləm/
8. Start 1) /st**a:**t/ 2) /st**ɑ:**t/
9. Perfect 1) /ˈp**ø:**fekt/ 2) /ˈp**ɜ:**fekt/ 3) /ˈp**æ:**fekt/
10. Productive 1) /prəˈdʌk.tɪv/ 2) /prəˈd**a**k.tɪv/ 3) /prəˈd**ø**k.tɪv/
11. Suffer 1) /ˈsʌf.**æ**/ 2) /ˈsʌf.**e**/ 3) /ˈsʌf.**ə**/
12. Year 1) /j**eə**/ 2) /j**ɪə**/ 3) /j**iə**/
13. There 1) /ð**eə**/ 2) /ð**æ:ə**/ 3) /ð**æə**/ 4) /ð**e:ə**/
14. Secure 1) /sɪˈkj**ʊə**/ 2) /sɪˈkj**ʉ**/ 3) /sɪˈkj**uo**/

15. Hot 1) /hɔt/ 2) /hɒt/

16. After 1) /ˈ**ɑ:**f.tə/ 2) /ˈ**a:**f.tə/

17. First 1) /ˈf**æ:**st/ 2) /ˈf**ø:**st/ 3) /ˈf**ɜ:**st/

18. Upgrade 1) /**ø**pˈgreɪd/ 2) /**ʌ**pˈgreɪd/ 3) /**a**pˈgreɪd/

19. Beginner 1) /bɪˈgɪn.**e**/ 2) /bɪˈgɪn.**æ**/ 3) /bɪˈgɪn.**ə**/

20. Here 1) /h**iə**/ 2) /h**ɪə**/ 3) /h**eə**/

21. Aircraft 1) /ˈ**eə**.krɑ:ft/ 2) /ˈ**æə**.krɑ:ft/ 3) /ˈ**e:ə**.krɑ:ft/ 4) /ˈ**æ:**ə.krɑ:ft/

22. Plural 1) /ˈpl**ʉ**.rəl/ 2) /ˈpl**uo**.rəl/ 3) /ˈpl**ʊə**.rəl/

23. Top 1) /tɔp/ 2) /t**ɒ**p/

24. Largely 1) /ˈl**ɑ:**dʒ.li/ 2) /ˈl**a:**dʒ.li/

25. **Uzdevums**

Lūdzu, ierakstiet atbilstošā lodziņā vienu no diviem vārdiem, kas tiks izrunāti teikumos. Jums ir iespēja izmēģināt pirmo teikumu.

Izmēģinājumam:

❖ **Cut** (*elektroenerģijas padeves pārtraukšana*) vai **Cat** (*kaķis*)

They were worried about the **CAT**.

Uzdevums:

- **Pen** (*pildspalva*) vai **Pin** (*adata*)

1. One of the passengers found a **PIN** on the floor.

- **Pet** (*iemīļots dzīvnieks*) vai **Pat** (*viegls uzsitiens*)

2. He gave me a **PAT**.

- **Cup** (*tasīte*) vai **Cap** (*cepure*)

3. He wanted to buy a **CUP**.

- **Luck** (*veiksme*) vai **Lock** (*slēdzene*)

4. It went well because of his **LOCK**.

- **Omission** (*izlaidums, nolaidība*) vai **Emission** (*izplūde, izmete*)

5. There is a serious **OMISSION**.

- **To cool down** (*nomierināt*) vai **To call down** (*nopulgot*)

6. Shall I **COOL** them **down**?

- **Pier** (*dambis*) vai **Pear** (*bumbieris*)

7. He bought a painting of a **PIER**.

- **Hoses** (*šļūtenes*) vai **Houses** (*mājas*)

8. Are these your **HOSES**?

- **Try** (*mēģinājums*) vai **Tray** (*paplāte*)

9. It was a nice **TRAY**.

- **Bitter** (*rūgts*) vai **Better** (*labāk*)

10. I feel **BETTER** about my plan.

- **Tech** (*tehnika*) vai **Tack** (*nagla ar platu galviņu*)

11. We need a new **TECH**.

- **Truck** (*kravas automašīna*) vai **Track** (*pēdas*)

12. There was a small **TRUCK** going up to the cabin.

- **Nut** (*uzgrieznis*) vai **Knot** (*mezgls*)

13. I'm struggling to loosen this tight **NUT**.

- **Addition** (*pielikums, papildinājums*) vai **Edition** (*izdevums*)

14. They promised there would be a new **EDITION**.

- **Food** (*barība*, *ēdiens*) vai **Ford** (*brasls*)

15. He forgot about the **FOOD**.

- **Here** (*šeit*) vai **Hair** (*mati*)

16. I can't see her **HAIR**.

- **No** (*nē*) vai **Now** (*tagad*)

17. **NO** (,) he didn't turn.

- **Light** (*viegls*) vai **Late** (*vēls*)

18. They thought it was very **LIGHT**.

- **Litter** (*izsvaidītas lietas*, *izmētāti papīri*) vai **Letter** (*vēstule*)

19. Where is your **LETTER**?

- **Ex** (*bijusī sieva*/*vīrs*) vai **Axe** (*cirvis*)

20. His **AXE** was in the living room.

- **Bug** (*kukainis*; *vabole*) vai **Bag** (*soma*)

21. There is a **BAG** on the table.

- **Duck** (*pīle*) vai **Dock** (*doks*)

22. They were aiming for the **DOCK**.

- **Allusion** (*atsaukšanās uz kaut ko vai kādu*) vai **Illusion** (*ilūzija*)

23. There is no point in your **ALLUSION**.

- **Fool** (*muļķis*) vai **Fall** (*rudens*)

24. This **FALL** is making me sad.

- **Beer** (*alus*) vai **Bear** (*lācis*)

25. This **BEER** is from Norway.

- **Clone** (*klons*) vai **Clown** (*klauns*)

26. Don't look like a **CLOWN**!

- **Mile** (*jūdze*) vai **Mail** (*pasts*)

27. What about your last **MAIL**?

28. Uzdevums

Lūdzu, noklausieties vienu no diviem uzrakstītiem vārdiem un atzīmējiet to testā. Jums ir iespēja izmēģināt.

Izmēģinājumam:

❖ **Bed** (*gulta*) __+___ vai **Bad** (*slikts*) __-___

1. **Bit** (*gabaliņš, druska*) __-___ vai **Bet** (*derības*) __+___
2. **Bet** (*derības*) ___-__ vai **Bat** (*sikspārnis*) __+___
3. **Luck** (*veiksme*) __+___ vai **Lack** (*trūkums, nepietiekamība*) __-___
4. **Fund** (*krājums*) ___-__ vai **Fond** (*mīlošs, maigs*) __+___
5. **Accept** (*pieņemt*) __+___ vai **Except** (*izņemot*) __-___
6. **Tool** (*darbarīks*) __+___ vai **Tall** (*garš*) __-___
7. **Tier** (*kārta*) __+___ vai **Tear** (*plīsums, caurums*) __-___
8. **Tone** (*tonis*) ___-__ vai **Town** (*pilsēta*) __+___
9. **Pay** (*samaksa*) ___+__ vai **Pie** (pīrāgs) __-___
10. **Sit** (*sēdēt*) __+___ vai **Set** (*komplekts, kolekcija*) __-___
11. **Pen** (*pildspalva*) __+___ vai **Pan** (*panna*) __-___
12. **Lug** (*rokturis*, tehn. *austiņa*) __-___ vai **Lag** (*atpalikšana, kavēšanās*) __+___
13. **Dull** (*truls, neass*) __+___ vai **Doll** (*lelle*) __-___

14. **Affect** (*ietekmēt*) __-___ vai **Effect** (*realizēt, izpildīt*) __+___

15. **Sue** (*iesūdzēt tiesā*) __-___ vai **Saw** (*zāģēt*) __+___

16. **We're** (*mēs esam*) __-___ vai **Where** (*kur*) __+___

17. **Crone** (*vecene*; *krona*) __+___ vai **Crown** (*kronis*; *vainags*) __-___

18. **Die** (*mirt*) __+___ vai **Day** (*diena*) __-___

Liels paldies par sadarbību!!! ☺

Appendix 7

Unpaired T-test results

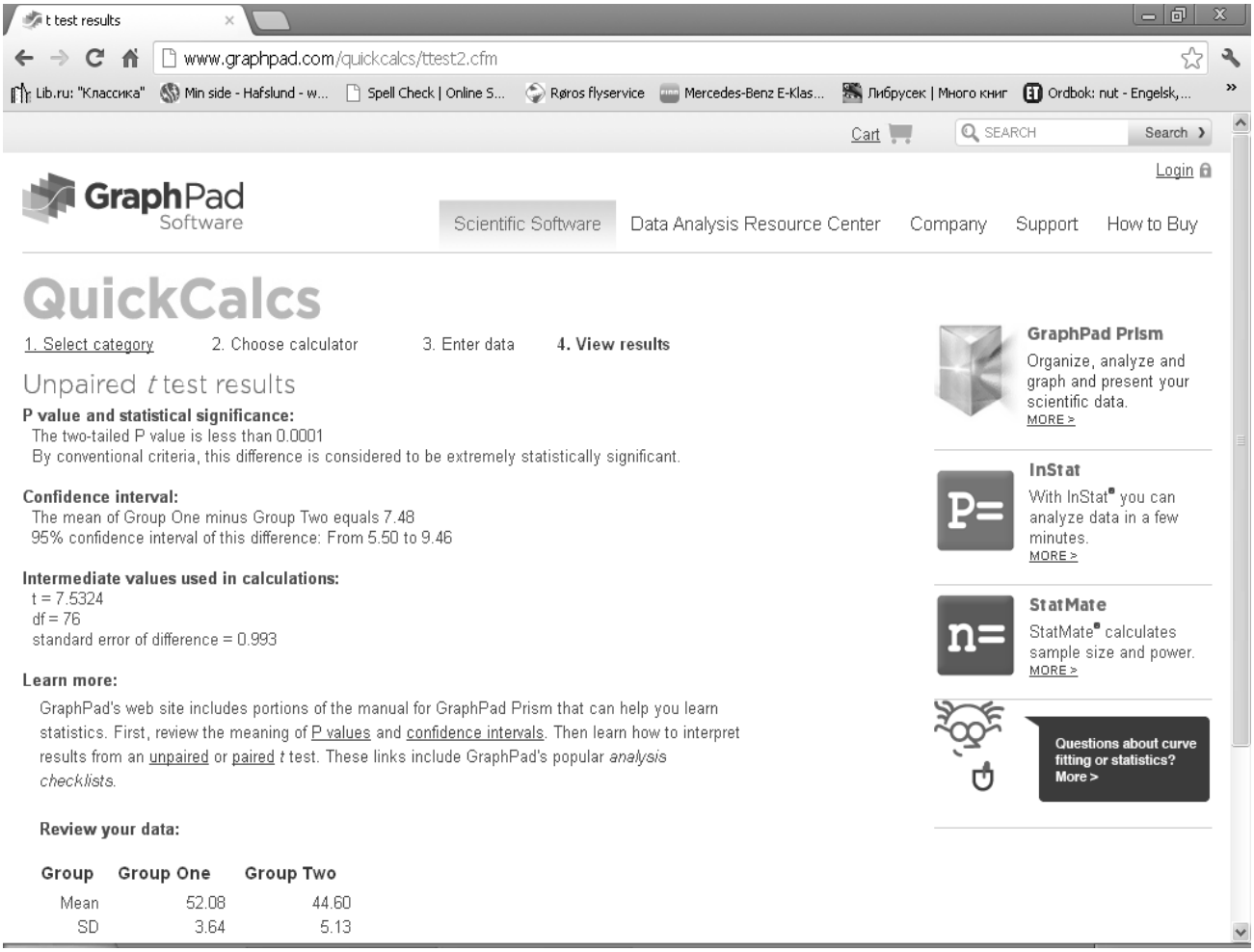


Figure 6: **Unpaired T-test results (Motulsky, 2012)**

Appendix 8, **Figures of part 1**

Test 1 (NO)

/ɜ:/–/æ:/–/ø:/

Question nr. 1, 9, 17

	/ɜ:/ (cor.)	**/æ:/** (unex.)	**/ø:/** (ex.)
NP1			3
NP2	1		2
NP3	3		
NP4	2		1
NP5			3
NP6	1		2
NP7	2		1
NP8	1		2
NP9	2		1
NP10			3
NP11		1	2
NP12	1		2
NP13	1		2
NP14	2	1	
NP15	1		2
NP16	1		2
NP17	1		2
NP18	1		2
NP19	1		2
NP20	1		2
NP21	1		2
NP22	1		2
NP23	1		2
NP24	1		2
NP25	1		2
NP26			3
NP27	1		2
NP28	2		1
NP29	2		1
NP30			3
NP31			3
NP32	2		1
NP33	1		2
NP34		1	2
NP35	1		2
NP36			3
NP37	1		
NP38	1		2
NP39	1		2
NP40	1		2
NP41			3
NP42	1		2
NP43	1		2
NP44	1		2
NP45	2		1
NP46	2		1
NP47	1		2
NP48			3
Total:	48	3	93
%:	33%	2%	65%

Test 1 (LV)

/ɜ:/–/æ:/–/ø:/

Question nr. 1, 9, 17

	/ɜ:/ (cor.)	**/æ:/** (ex.)	**/ø:/** (unex.)
LP1	2		1
LP2	1	1	1
LP3	1		2
LP4	1	2	
LP5	1		2
LP6			3
LP7	2	1	
LP8		3	
LP9	1	2	
LP10	2		1
LP11	1		2
LP12			3
LP13	1		2
LP14	1		2
LP15	2		1
LP16	3		
LP17	3		
LP18	1		2
LP19		1	2
LP20			3
LP21	1		2
LP22		3	
LP23		3	
LP24	2	1	
LP25	2		1
LP26	1		2
LP27	1	1	1
LP28	1		2
LP29	1		2
LP30	1		2
Total:	33	18	39
%:	37%	20%	43%

Test 1 (NO)
/ʌ/–/a/–/ø/
Question nr. 2, 10, 18

	/ʌ/ (cor.)	/a/ (unex.)	/ø/ (ex.)
NP1		2	1
NP2	1	2	
NP3	1		2
NP4	2		1
NP5	3		
NP6	3		
NP7	3		
NP8	1		2
NP9	1	1	1
NP10	2	1	
NP11	2		1
NP12	2		1
NP13	1	1	1
NP14	2		1
NP15	1	1	1
NP16		1	2
NP17	2	1	
NP18	3		
NP19	2	1	
NP20	2		1
NP21	2	1	
NP22	1	1	1
NP23	1	2	
NP24	2	1	
NP25	2	1	
NP26	2	1	
NP27	1		2
NP28	3		
NP29	2		1
NP30	1		2
NP31	3		
NP32	2		1
NP33	2	1	
NP34	1	2	
NP35	2	1	
NP36	3		
NP37	2		1
NP38	3		
NP39	2	1	
NP40	1	1	1
NP41	2	1	
NP42	3		
NP43	2		1
NP44	2	1	
NP45	2	1	
NP46	2	1	
NP47	1	1	1
NP48	1	1	1
Total:	87	30	27
%:	60%	21%	19%

Test 1 (LV)
/ʌ/–/a/–/ø/
Question nr. 2, 10, 18

	/ʌ/ (cor.)	/a/ (ex.)	/ø/ (unex.)
LP1		2	1
LP2	2	1	
LP3	2	1	
LP4		3	
LP5	2	1	
LP6	1	1	1
LP7	2	1	
LP8		3	
LP9	1	2	
LP10	2	1	
LP11	1	2	
LP12	1	1	1
LP13		1	2
LP14	3		
LP15	2	1	
LP16	1	2	
LP17	3		
LP18	3		
LP19	1		2
LP20	2	1	
LP21	2	1	
LP22	1	2	
LP23	1	2	
LP24		3	
LP25	1	1	1
LP26	2	1	
LP27		1	2
LP28	2	1	
LP29	2	1	
LP30	2	1	
Total:	42	38	10
%:	47%	42%	11%

Test 1 (NO)
/ə/–/e/–/æ/
Question nr. 3, 11, 19

	/ə/ (cor.; ex.)	/e/ (unex.)	/æ/ (unex.)
NP1	1		2
NP2	2		1
NP3	3		
NP4	1	1	1
NP5	3		
NP6	1		2
NP7	1		2
NP8	1		2
NP9	1		2
NP10			3
NP11	2		1
NP12		1	2
NP13	2		1
NP14	1	1	1
NP15	1		2
NP16	1		2
NP17		1	2
NP18	3		
NP19	1		2
NP20	2	1	
NP21	2	1	
NP22	2	1	
NP23	2		1
NP24	1		2
NP25			3
NP26			3
NP27	1		2
NP28			3
NP29	1		2
NP30	1		2
NP31	2		1
NP32	1		2
NP33			3
NP34	2		1
NP35	1		2
NP36	1		2
NP37	1		2
NP38	2		1
NP39		1	2
NP40			3
NP41	3		
NP42	1		2
NP43	2		1
NP44	2		1
NP45	1		2
NP46	1		2
NP47	1		2
NP48	1		2
Total:	59	8	77
%:	41%	6%	53%

Test 1 (LV)
/ə/–/e/–/æ/
Question nr. 3, 11, 19

	/ə/ (cor.)	/e/ (ex.)	/æ/ (ex.)
LP1	1		2
LP2	1		2
LP3	1		2
LP4		2	1
LP5	1		2
LP6	1	1	1
LP7	1		2
LP8	1	1	1
LP9	2		1
LP10		1	2
LP11	2		1
LP12	2		1
LP13	1	1	1
LP14	1	1	1
LP15	1	1	1
LP16	2		1
LP17	1		2
LP18	2		1
LP19	2	1	
LP20	1	1	1
LP21	2	1	
LP22	1		2
LP23			3
LP24			3
LP25	1		2
LP26		2	1
LP27	2		1
LP28	1		2
LP29	1	2	
LP30			3
Total:	32	15	43
%:	35%	17%	48%

Test 1 (NO)

/ɪə/–/iə/–/eə/

Question nr. 4, 12, 20

	/ɪə/ (cor.)	**/iə/** (unex.)	**/eə/** (ex.)
NP1	2		1
NP2	1		2
NP3			3
NP4	2		1
NP5		1	2
NP6	2		1
NP7	2		1
NP8	2		1
NP9	1	1	1
NP10		1	2
NP11			3
NP12			3
NP13	1	1	1
NP14	1	1	1
NP15	1	1	1
NP16	1		2
NP17	1		2
NP18	2		1
NP19			3
NP20	1		2
NP21	1		2
NP22	1	1	1
NP23	1		2
NP24			3
NP25	1		2
NP26	1		2
NP27	1		2
NP28	2		1
NP29	1		2
NP30			3
NP31		1	2
NP32			3
NP33	1		2
NP34			3
NP35			3
NP36			3
NP37			3
NP38	1		2
NP39	1		2
NP40	2		1
NP41	1	1	1
NP42		1	2
NP43	3		
NP44	1		2
NP45	1		2
NP46	1	1	1
NP47	1		2
NP48	1	1	1
Total:	43	12	89
%:	30%	8%	62%

Test 1 (LV)

/ɪə/–/iə/–/eə/

Question nr. 4, 12, 20

	/ɪə/ (cor.)	**/iə/** (ex.)	**/eə/** (unex.)
LP1	1	1	1
LP2			3
LP3		1	2
LP4	1		2
LP5	3		
LP6		2	1
LP7	1	2	
LP8		3	
LP9	1	2	
LP10	1		2
LP11	1		2
LP12	2		1
LP13	1		2
LP14	2		1
LP15	1	1	1
LP16	1		2
LP17	1	1	1
LP18	1		2
LP19	1	2	
LP20		1	2
LP21	1	1	1
LP22	1	1	1
LP23		3	
LP24	1	2	
LP25	1	1	1
LP26	2	1	
LP27		1	2
LP28		1	2
LP29	2		1
LP30	1	1	1
Total:	28	28	34
%:	31%	31%	38%

Test 1 (NO)

/eə/–/æə/–/eːə/–/æːə/

Question nr. 5, 13, 21

	/eə/ (cor.)	**/æə/** (unex.)	**/eːə/** (ex.)	**/æːə/** (ex.)
NP1	3			
NP2	3			
NP3	2		1	
NP4	3			
NP5	2		1	
NP6	1		2	
NP7	1	2		
NP8	1		2	
NP9	3			
NP10	2		1	
NP11	2		1	
NP12	3			
NP13	3			
NP14	2		1	
NP15	3			
NP16	3			
NP17	2		1	
NP18	3			
NP19	3			
NP20	3			
NP21	2		1	
NP22	3			
NP23	3			
NP24	2		1	
NP25	2	1		
NP26	2		1	
NP27	2		1	
NP28	2		1	
NP29	2	1		
NP30	3			
NP31	3			
NP32			3	
NP33	2	1		
NP34	3			
NP35	3			
NP36	3			
NP37	3			
NP38	3			
NP39	2		1	
NP40	2		1	
NP41	2		1	
NP42	2		1	
NP43	3			
NP44	1		2	
NP45	2		1	
NP46	3			
NP47	3			
NP48	3			
Total:	114	5	25	0
%:	79%	4%	17%	0%

Test 1 (LV)

/eə/–/æə/–/eːə/–/æːə/

Question nr. 5, 13, 21

	/eə/ (cor.)	**/æə/** (ex.)	**/eːə/** (unex.)	**/æːə/** (unex.)
LP1	2		1	
LP2	1	1	1	
LP3	2		1	
LP4	2	1		
LP5	3			
LP6	2		1	
LP7	2	1		
LP8	1	2		
LP9	2	1		
LP10	2		1	
LP11	2	1		
LP12	3			
LP13	2			1
LP14	3			
LP15	3			
LP16	2		1	
LP17	2		1	
LP18	3			
LP19	1		2	
LP20	1		2	
LP21	3			
LP22		1		2
LP23	1	2		
LP24		3		
LP25	2		1	
LP26	3			
LP27	1		2	
LP28	1		2	
LP29	3			
LP30	3			
Total:	58	13	16	3
%:	64%	15%	18%	3%

Test 1 (NO)

/ʊə/–/uo/–/ʉ/

Question nr. 6, 14, 22

	/ʊə/ (cor.)	**/uo/** (unex.)	**/ʉ/** (ex.)
NP1	2		1
NP2	1	1	1
NP3	1		2
NP4		2	1
NP5	2	1	
NP6	2	1	
NP7	2		1
NP8	2		1
NP9	2	1	
NP10	1	2	
NP11	1		2
NP12	2		1
NP13	1	1	1
NP14	2		1
NP15	1	1	1
NP16	2		1
NP17	2	1	
NP18	1	1	1
NP19	2	1	
NP20	1	1	1
NP21	2		1
NP22	3		
NP23	3		
NP24	3		
NP25	2	1	
NP26	2	1	
NP27	1		2
NP28	1		2
NP29	2	1	
NP30	1	1	1
NP31	1	1	1
NP32	3		
NP33	2	1	
NP34	1	1	1
NP35	2		1
NP36	2	1	
NP37	3		
NP38	1	1	1
NP39	1	1	1
NP40	3		
NP41	2		1
NP42	3		
NP43	3		
NP44	1	1	1
NP45	2	1	
NP46	1	1	1
NP47	2	1	
NP48	1	1	1
Total:	84	29	31
%:	58%	20%	22%

Test 1 (LV)

/ʊə/–/uo/–/ʉ/

Question nr. 6, 14, 22

	/ʊə/ (cor.)	**/uo/** (ex.)	**/ʉ/** (unex.)
LP1	1	1	1
LP2		3	
LP3			3
LP4	1	1	1
LP5	1		2
LP6		3	
LP7		3	
LP8		3	
LP9		3	
LP10	1	1	1
LP11	2		1
LP12	1	1	1
LP13	1	2	
LP14	1	2	
LP15	1		2
LP16	1	1	1
LP17	1	1	1
LP18	1	2	
LP19	2		1
LP20	1	1	1
LP21	2	1	
LP22	1	2	
LP23		3	
LP24		3	
LP25	2	1	
LP26	1	1	1
LP27	1	2	
LP28		1	2
LP29		2	1
LP30	1	1	1
Total:	24	45	21
%:	27%	50%	23%

Test 1 (NO)

/ɒ/–/ɔ/

Question nr. 7, 15, 23

	/ɒ/ (cor.)	/ɔ/ (ex.)
NP1		3
NP2	1	2
NP3		3
NP4	3	
NP5	3	
NP6	1	2
NP7		3
NP8		3
NP9		3
NP10	2	1
NP11	2	1
NP12		3
NP13	3	
NP14	3	
NP15	1	2
NP16	1	2
NP17	2	1
NP18	3	
NP19	2	1
NP20	1	2
NP21		3
NP22	2	1
NP23	1	2
NP24	1	2
NP25		3
NP26	1	2
NP27	3	
NP28	2	1
NP29	2	1
NP30	1	2
NP31	1	2
NP32	1	2
NP33	1	2
NP34	2	1
NP35	2	1
NP36	2	1
NP37	2	1
NP38	1	2
NP39	3	
NP40	1	2
NP41	1	2
NP42	2	1
NP43	3	
NP44	2	1
NP45	2	1
NP46	1	2
NP47		3
NP48	2	1
Total:	70	74
%:	49%	51%

Test 1 (LV)

/ɒ/–/ɔ/

Question nr. 7, 15, 23

	/ɒ/ (cor.)	/ɔ/ (ex.)
LP1	2	1
LP2	1	2
LP3	2	1
LP4	2	1
LP5	3	
LP6	1	2
LP7	2	1
LP8	1	2
LP9	2	1
LP10	3	
LP11	1	2
LP12	2	1
LP13		3
LP14	3	
LP15	2	1
LP16	1	2
LP17	1	2
LP18	2	1
LP19	2	1
LP20	2	1
LP21	1	2
LP22	2	1
LP23	1	2
LP24	1	2
LP25	2	1
LP26	1	2
LP27	1	2
LP28		3
LP29	2	1
LP30	1	2
Total:	47	43
%:	52%	48%

Test 1 (NO)

/ɑ:/–/a/

Question nr. 8, 16, 24

	/ɑ:/ (cor.)	/**a**/ (ex.)
NP1	3	
NP2	2	1
NP3	3	
NP4	2	1
NP5	3	
NP6	3	
NP7	2	1
NP8	2	1
NP9	3	
NP10	3	
NP11	1	2
NP12	3	
NP13	2	1
NP14	2	1
NP15	2	1
NP16	2	1
NP17	3	
NP18	2	1
NP19	3	
NP20	3	
NP21	2	1
NP22	3	
NP23	3	
NP24	3	
NP25	2	1
NP26	2	1
NP27	2	1
NP28	3	
NP29	3	
NP30	3	
NP31	3	
NP32	2	1
NP33	2	1
NP34	1	2
NP35	1	2
NP36	2	1
NP37	2	1
NP38	3	
NP39	2	1
NP40	2	1
NP41	3	
NP42	2	1
NP43	3	
NP44	3	
NP45	3	
NP46	3	
NP47	3	
NP48	3	
Total:	118	26
%:	82%	18%

Test 1 (LV)

/ɑ:/–/a/

Question nr. 8, 16, 24

	/ɑ:/ (cor.)	/**a**/ (ex.)
LP1	2	1
LP2	2	1
LP3	3	
LP4	3	
LP5	2	1
LP6	3	
LP7	2	1
LP8		3
LP9	3	
LP10	3	
LP11	3	
LP12	2	1
LP13	2	1
LP14	2	1
LP15	3	
LP16	2	1
LP17	3	
LP18	3	
LP19	3	
LP20	2	1
LP21	3	
LP22		3
LP23		3
LP24	2	1
LP25	3	
LP26	3	
LP27	2	1
LP28	2	1
LP29	1	2
LP30	2	1
Total:	66	24
%:	73%	27%

Appendix 9, **Figures of part 2**

Test 2 (NO)

	/ɪ/–/e/ Question nr. 1		/e/–/ɪ/ Question nr. 10, 19	
	/ɪ/ (cor.)	/e/ (incor.)	/e/ (cor.)	/ɪ/ (incor.)
NP1	1		2	
NP2	1		2	
NP3	1		2	
NP4	1		2	
NP5	1		2	
NP6	1		2	
NP7	1		2	
NP8		1	1	1
NP9	1		2	
NP10	1		2	
NP11	1		2	
NP12	1		2	
NP13	1		2	
NP14	1		2	
NP15	1		2	
NP16	1		2	
NP17	1		2	
NP18	1		2	
NP19	1		2	
NP20	1		2	
NP21	1		2	
NP22	1		2	
NP23	1		2	
NP24	1		2	
NP25	1		2	
NP26	1		2	
NP27	1		2	
NP28		1	2	
NP29	1		2	
NP30	1		2	
NP31	1		2	
NP32		1	2	
NP33	1		2	
NP34	1		2	
NP35	1		2	
NP36	1		2	
NP37	1		2	
NP38	1		2	
NP39	1		2	
NP40	1		2	
NP41		1	2	
NP42	1		2	
NP43	1		2	
NP44	1		2	
NP45	1		2	
NP46	1		2	
NP47	1		2	
NP48	1		2	
Total:	44	4	95	1
%:	30%	3%	66%	1%
%:	96%		4%	
% for each d.:	92%	8%	99%	1%

Test 2 (LV)

	/ɪ/–/e/ Question nr. 1		/e/–/ɪ/ Question nr. 10, 19	
	/ɪ/ (cor.)	/e/ (incor.)	/e/ (cor.)	/ɪ/ (incor.)
LP1	1		2	
LP2	1		2	
LP3	1		2	
LP4	1		2	
LP5	1		2	
LP6		1	2	
LP7		1	2	
LP8	1		2	
LP9	1		2	
LP10	1		1	1
LP11	1		2	
LP12	1		2	
LP13		1	2	
LP14	1		2	
LP15	1		2	
LP16	1		2	
LP17	1		2	
LP18	1		2	
LP19	1		2	
LP20	1		2	
LP21	1		2	
LP22	1		2	
LP23	1		2	
LP24	1		2	
LP25	1		1	1
LP26		1	1	1
LP27	1		2	
LP28				
LP29		1	2	
LP30	1		2	
Total:	24	5	55	3
%:	28%	6%	63%	3%
%:	91%		9%	
% for each d.:	83%	17%	95%	5%

Test 2 (NO)

	/**æ**/–/e/ Question nr. 2, 20		/**e**/–/æ/ Question nr. 11	
	/**æ**/ (cor.)	/e/ (incor.)	/**e**/ (cor.)	/æ/ (incor.)
NP1	2			1
NP2	2		1	
NP3	1	1	1	
NP4	2		1	
NP5	2		1	
NP6	2		1	
NP7	2		1	
NP8	2		1	
NP9	2			1
NP10	2		1	
NP11	2		1	
NP12	2		1	
NP13	1	1		1
NP14	1	1	1	
NP15	2		1	
NP16	2		1	
NP17	2		1	
NP18	2		1	
NP19	2		1	
NP20	2		1	
NP21	1	1	1	
NP22	2		1	
NP23	2		1	
NP24	2		1	
NP25	2		1	
NP26	2			1
NP27	2		1	
NP28	2		1	
NP29	2		1	
NP30	2		1	
NP31	2		1	
NP32	2		1	
NP33	2		1	
NP34	2		1	
NP35	2		1	
NP36	2		1	
NP37	2		1	
NP38	2		1	
NP39	2		1	
NP40	2		1	
NP41	2		1	
NP42	2		1	
NP43	2		1	
NP44	2		1	
NP45	2		1	
NP46	2		1	
NP47	2		1	
NP48	2		1	
Total:	92	4	44	4
%:	64%	3%	30%	3%
%:	94%		6%	
% for each direction:	96%	4%	92%	8%

Test 2 (LV)

	/**æ**/–/e/ Question nr. 2, 20		/**e**/–/æ/ Question nr. 11	
	/**æ**/ (cor.)	/e/ (incor.)	/**e**/ (cor.)	/æ/ (incor.)
LP1	1	1		1
LP2	2		1	
LP3	2			1
LP4	1	1		1
LP5	2			1
LP6	1	1		1
LP7	1	1	1	
LP8	1	1		1
LP9	2			1
LP10	2			1
LP11	2		1	
LP12	2			1
LP13	1	1		1
LP14	2			1
LP15	1	1	1	
LP16	2			1
LP17	2			1
LP18	2		1	
LP19	1	1	1	
LP20	2			1
LP21	2		1	
LP22	2		1	
LP23	1	1		1
LP24	2			1
LP25		2	1	
LP26	2		1	
LP27	1	1	1	
LP28				
LP29	1	1	1	
LP30	1	1	1	
Total:	44	14	13	16
%:	51%	16%	15%	18%
%:	66%		34%	
% for each d.:	76%	24%	45%	55%

Test 2 (NO)

	/æ/–/ʌ/		/ʌ/–/æ/	
	Question nr. 21		Question nr. 3, 12	
	/æ/ (cor.)	/ʌ/ (incor.)	/ʌ/ (cor.)	/æ/ (incor.)
NP1	1		2	
NP2	1		2	
NP3	1		1	1
NP4	1			2
NP5	1		2	
NP6	1		2	
NP7	1		2	
NP8	1		2	
NP9	1		2	
NP10	1		2	
NP11	1		2	
NP12	1		2	
NP13	1		1	1
NP14	1		1	1
NP15	1		2	
NP16	1		2	
NP17	1		2	
NP18	1		2	
NP19	1		2	
NP20	1		2	
NP21	1		2	
NP22	1		2	
NP23	1		2	
NP24	1		2	
NP25	1		2	
NP26	1		2	
NP27	1		2	
NP28	1		2	
NP29	1		2	
NP30	1		2	
NP31	1		2	
NP32	1		2	
NP33	1		2	
NP34	1		2	
NP35	1		2	
NP36	1		2	
NP37	1		2	
NP38	1		2	
NP39	1		2	
NP40	1		2	
NP41	1		2	
NP42	1		1	1
NP43	1		2	
NP44	1		2	
NP45	1		2	
NP46	1		2	
NP47	1		2	
NP48	1		2	
Total:	48	0	90	6
%:	33%	0%	63%	4%
%:	96%		4%	
% for each direction:	100%	0%	94%	6%

Test 2 (LV)

	/æ/–/ʌ/		/ʌ/–/æ/	
	Question nr. 21		Question nr. 3, 12	
	/æ/ (cor.)	/ʌ/ (incor.)	/ʌ/ (cor.)	/æ/ (incor.)
LP1	1			2
LP2	1		2	
LP3		1	2	
LP4	1		2	
LP5	1		1	1
LP6	1			2
LP7	1		1	1
LP8	1			2
LP9	1		2	
LP10	1		2	
LP11	1		1	1
LP12	1		1	1
LP13	1		2	
LP14	1		1	1
LP15	1		1	1
LP16	1			2
LP17	1			2
LP18	1			2
LP19		1	1	1
LP20	1		2	
LP21	1		2	
LP22		1	2	
LP23	1		2	
LP24	1		2	
LP25	1			2
LP26	1		1	1
LP27		1	2	
LP28				
LP29	1		1	1
LP30	1		2	
Total:	25	4	35	23
%:	29%	5%	40%	26%
%:	69%		31%	
% for each d.:	86%	14%	60%	40%

Test 2 (NO)

	/ɒ/–/ʌ/ Question nr. 4, 22		/ʌ/–/ɔ/ Question nr. 13	
	/ɒ/ (cor.)	/ʌ/ (incor.)	/ʌ/ (cor.)	/ɔ/ (incor.)
NP1	2			1
NP2	2		1	
NP3	1	1		1
NP4	1	1		1
NP5	2			1
NP6	2			1
NP7	2		1	
NP8	2			1
NP9	2			1
NP10	1	1	1	
NP11	2			1
NP12	2		1	
NP13	2		1	
NP14	1	1		1
NP15	2			1
NP16	2		1	
NP17	2		1	
NP18	2		1	
NP19	2			1
NP20	1	1	1	
NP21	2			1
NP22	2			1
NP23	2		1	
NP24	2		1	
NP25	2		1	
NP26	2		1	
NP27	2		1	
NP28	2			1
NP29	2		1	
NP30	2		1	
NP31	2			1
NP32	2			1
NP33	2			1
NP34	2			1
NP35	2		1	
NP36	2		1	
NP37	2		1	
NP38	2		1	
NP39	2		1	
NP40	2			1
NP41	2		1	
NP42	1	1		1
NP43	2		1	
NP44	2		1	
NP45	2		1	
NP46	2			1
NP47	2			1
NP48	2			1
Total:	90	6	25	23
%:	63%	4%	17%	16%
%:	80%		20%	
% for each direction:	94%	6%	52%	48%

Test 2 (LV)

	/ɒ/–/ʌ/ Question nr. 4, 22		/ʌ/–/ɔ/ Question nr. 13	
	/ɒ/ (cor.)	/ʌ/ (incor.)	/ʌ/ (cor.)	/ɔ/ (incor.)
LP1	2			1
LP2	2			1
LP3	1	1	1	
LP4	2			1
LP5	2			1
LP6	2			1
LP7	2		1	
LP8	2		1	
LP9	2		1	
LP10	2		1	
LP11	1	1		1
LP12	2		1	
LP13	2		1	
LP14	1	1	1	
LP15	1	1		1
LP16	2		1	
LP17	1	1	1	
LP18	1	1		1
LP19	1	1	1	
LP20	2			1
LP21	2		1	
LP22	2		1	
LP23	2		1	
LP24	2			1
LP25		2	1	
LP26		2	1	
LP27	2			1
LP28				
LP29	2		1	
LP30	2		1	
Total:	47	11	18	11
%:	54%	13%	20%	13%
%:	74%		26%	
% for each d.:	81%	19%	62%	38%

Test 2 (NO)

	/ɪ/–/ə/ Question nr. 14		/ə/–/ɪ/ Question nr. 5, 23	
	/ɪ/ (cor.)	/ə/ (incor.)	/ə/ (cor.)	/ɪ/ (incor.)
NP1		1	1	1
NP2	1			2
NP3	1		1	1
NP4	1		1	1
NP5	1		1	1
NP6	1		1	1
NP7	1			2
NP8	1		2	
NP9	1			2
NP10	1		1	1
NP11	1		2	
NP12	1			2
NP13	1		2	
NP14	1			2
NP15	1		1	1
NP16	1		2	
NP17	1		2	
NP18	1			2
NP19	1		1	1
NP20	1		2	
NP21	1			2
NP22	1		2	
NP23	1		1	1
NP24	1		1	1
NP25	1		1	1
NP26	1			2
NP27	1		1	1
NP28	1			2
NP29	1		1	1
NP30	1		1	1
NP31	1		1	1
NP32	1		1	1
NP33	1			2
NP34	1			2
NP35	1			2
NP36	1		1	1
NP37	1		1	1
NP38	1		1	1
NP39	1			2
NP40	1		1	1
NP41	1		1	1
NP42	1			2
NP43	1			2
NP44	1		1	1
NP45	1		2	
NP46	1			2
NP47	1			2
NP48	1			2
Total:	47	1	38	58
%:	32%	1%	26%	40%
%:	60%		40%	
% for each direction:	98%	2%	40%	60%

Test 2 (LV)

	/ɪ/–/ə/ Question nr. 14		/ə/–/ɪ/ Question nr. 5, 23	
	/ɪ/ (cor.)	/ə/ (incor.)	/ə/ (cor.)	/ɪ/ (incor.)
LP1	1		1	1
LP2	1			2
LP3		1		2
LP4	1			2
LP5	1			2
LP6	1		1	1
LP7	1		1	1
LP8	1		1	1
LP9	1			2
LP10		1		2
LP11	1			2
LP12	1			2
LP13	1		1	1
LP14	1			2
LP15	1			2
LP16	1		1	1
LP17	1			2
LP18		1	1	1
LP19	1		1	1
LP20		1		2
LP21	1			2
LP22	1		2	
LP23	1		1	1
LP24	1			2
LP25	1			2
LP26	1		1	1
LP27	1			2
LP28				
LP29	1			2
LP30	1		1	1
Total:	25	4	13	45
%:	29%	4%	15%	52%
%:	44%		56%	
% for each d.:	86%	14%	22%	78%

Test 2 (NO)

	/**u:**/–/ɔ:/ Question nr. 6, 15		/**ɔ:**/–/u:/ Question nr. 24	
	/**u:**/ (cor.)	/ɔ:/ (incor.)	/**ɔ:**/ (cor.)	/u:/ (incor.)
NP1	2		1	
NP2	2		1	
NP3	1	1	1	
NP4	2		1	
NP5	2		1	
NP6	2		1	
NP7	2		1	
NP8	2		1	
NP9	2		1	
NP10	2		1	
NP11	2		1	
NP12	2			1
NP13	1	1	1	
NP14	2		1	
NP15	2		1	
NP16	1	1	1	
NP17	1	1	1	
NP18	1	1	1	
NP19	2			1
NP20	2		1	
NP21	1	1	1	
NP22	1	1	1	
NP23	2		1	
NP24	2		1	
NP25	2		1	
NP26	1	1	1	
NP27	2		1	
NP28	2		1	
NP29	2			1
NP30	2		1	
NP31	1	1	1	
NP32	1	1		1
NP33	2			1
NP34	2		1	
NP35	2		1	
NP36	2		1	
NP37	2		1	
NP38	2		1	
NP39	2		1	
NP40	1	1	1	
NP41	2		1	
NP42	1	1		1
NP43	2		1	
NP44	2		1	
NP45	1	1	1	
NP46	1	1		1
NP47	2		1	
NP48	2		1	
Total:	82	14	41	7
%:	57%	10%	28%	5%
%:	85%		15%	
% for each direction:	85%	15%	85%	15%

Test 2 (LV)

	/**u:**/–/ɔ:/ Question nr. 6, 15		/**ɔ:**/–/u:/ Question nr. 24	
	/**u:**/ (cor.)	/ɔ:/ (incor.)	/**ɔ:**/ (cor.)	/u:/ (incor.)
LP1	2		1	
LP2	2			1
LP3	2		1	
LP4	2		1	
LP5	2		1	
LP6	2		1	
LP7	2			1
LP8	1	1	1	
LP9	2			1
LP10	2			1
LP11	2		1	
LP12	1	1	1	
LP13	2			1
LP14	2		1	
LP15	2			1
LP16	2			1
LP17	1	1		1
LP18	2		1	
LP19	2			1
LP20	2		1	
LP21	2		1	
LP22	2			1
LP23	2			1
LP24	2			1
LP25	2			1
LP26	2			1
LP27	2			1
LP28				
LP29	2			1
LP30	2		1	
Total:	55	3	13	16
%:	63%	4%	15%	18%
%:	78%		22%	
% for each d.:	95%	5%	45%	55%

Test 2 (NO)

	/ɪə/–/eə/ Question nr. 7, 25		/eə/–/ɪə/ Question nr. 16	
	/ɪə/ (cor.)	/eə/ (incor.)	/eə/ (cor.)	/ɪə/ (incor.)
NP1		2	1	
NP2	2		1	
NP3	2			1
NP4		2	1	
NP5	2		1	
NP6	1	1	1	
NP7	2		1	
NP8	1	1	1	
NP9	1	1	1	
NP10	1	1	1	
NP11		2	1	
NP12	1	1	1	
NP13	1	1	1	
NP14	1	1	1	
NP15	1	1	1	
NP16		2	1	
NP17	2		1	
NP18	1	1	1	
NP19	1	1		1
NP20	1	1		1
NP21	1	1	1	
NP22	1	1	1	
NP23	1	1	1	
NP24	2		1	
NP25	1	1		1
NP26	1	1	1	
NP27	2		1	
NP28	1	1	1	
NP29	2		1	
NP30		2	1	
NP31	1	1	1	
NP32		2	1	
NP33		2	1	
NP34	2			1
NP35		2		1
NP36	2		1	
NP37	1	1	1	
NP38	1	1	1	
NP39	1	1	1	
NP40	1	1		1
NP41	1	1		1
NP42	1	1		1
NP43	2		1	
NP44	1	1	1	
NP45	2		1	
NP46	1	1	1	
NP47		2	1	
NP48	1	1	1	
Total:	51	45	39	9
%:	36%	31%	27%	6%
%:	63%		37%	
% for each direction:	53%	47%	81%	19%

Test 2 (LV)

	/ɪə/–/eə/ Question nr. 7, 25		/eə/–/ɪə/ Question nr. 16	
	/ɪə/ (cor.)	/eə/ (incor.)	/eə/ (cor.)	/ɪə/ (incor.)
LP1		2	1	
LP2	1	1	1	
LP3	2			1
LP4	1	1	1	
LP5		2	1	
LP6	1	1		1
LP7	1	1		1
LP8		2	1	
LP9		2	1	
LP10	2			1
LP11	2		1	
LP12	1	1		1
LP13		2	1	
LP14	2		1	
LP15		2	1	
LP16	1	1	1	
LP17	1	1	1	
LP18	1	1		1
LP19		2		1
LP20		2		1
LP21	1	1	1	
LP22		2	1	
LP23		2	1	
LP24	2		1	
LP25		2		1
LP26	1	1	1	
LP27	2		1	
LP28				
LP29	1	1	1	
LP30	1	1	1	
Total:	24	34	20	9
%:	28%	39%	23%	10%
%	51%		49%	
% for each d.:	41%	59%	69%	31%

Test 2 (NO)

	/**əʊ**/–/aʊ/ Question nr. 8, 17		/**aʊ**/–/əʊ/ Question nr. 26	
	/**əʊ**/ (cor.)	/aʊ/ (incor.)	/**aʊ**/ (cor.)	/əʊ/ (incor.)
NP1	2		1	
NP2	2		1	
NP3	1	1	1	
NP4	2		1	
NP5	2		1	
NP6	2		1	
NP7	2		1	
NP8	2		1	
NP9	1	1	1	
NP10	2		1	
NP11	2		1	
NP12	1	1	1	
NP13	1	1	1	
NP14	2		1	
NP15	2		1	
NP16	2		1	
NP17	2		1	
NP18	2		1	
NP19	2		1	
NP20	2		1	
NP21	2		1	
NP22	1	1	1	
NP23	2		1	
NP24	2		1	
NP25	2		1	
NP26	2		1	
NP27	2		1	
NP28	2		1	
NP29	2		1	
NP30	2		1	
NP31	2		1	
NP32	1	1	1	
NP33	1	1	1	
NP34	2		1	
NP35	2		1	
NP36	2		1	
NP37	2		1	
NP38	2		1	
NP39	2		1	
NP40	2		1	
NP41	2		1	
NP42	2		1	
NP43	2		1	
NP44	2		1	
NP45	2		1	
NP46	2		1	
NP47	2		1	
NP48	2		1	
Total:	89	7	48	0
%:	62%	5%	33%	0%
%	95%		5%	
% for each direction:	93%	7%	100%	0%

Test 2 (LV)

	/**əʊ**/–/aʊ/ Question nr. 8, 17		/**aʊ**/–/əʊ/ Question nr. 26	
	/**əʊ**/ (cor.)	/aʊ/ (incor.)	/**aʊ**/ (cor.)	/əʊ/ (incor.)
LP1		2	1	
LP2	2		1	
LP3	1	1	1	
LP4	1	1	1	
LP5	2		1	
LP6		2	1	
LP7	1	1	1	
LP8		2	1	
LP9		2	1	
LP10	1	1	1	
LP11	1	1	1	
LP12	2		1	
LP13	1	1	1	
LP14	2		1	
LP15	2		1	
LP16	1	1	1	
LP17	2		1	
LP18	1	1	1	
LP19	1	1	1	
LP20	1	1	1	
LP21	2		1	
LP22	1	1	1	
LP23	2		1	
LP24	1	1	1	
LP25	1	1	1	
LP26	1	1	1	
LP27	2		1	
LP28				
LP29	2		1	
LP30	2		1	
Total:	36	22	29	0
%:	42%	25%	33%	0%
%:	75%		25%	
% for each d.:	62%	38%	100%	0%

Test 2 (NO)

	/**eɪ**/–/aɪ/ Question nr. 9, 27		/**aɪ**/–/eɪ/ Question nr. 18	
	/**eɪ**/ (cor.)	/aɪ/ (incor.)	/**aɪ**/ (cor.)	/eɪ/ (incor.)
NP1	2		1	
NP2	2		1	
NP3	1	1	1	
NP4	2		1	
NP5	2		1	
NP6	2		1	
NP7	2		1	
NP8	2		1	
NP9	2		1	
NP10	2		1	
NP11	2		1	
NP12	2		1	
NP13	1	1	1	
NP14	2		1	
NP15	2		1	
NP16	2		1	
NP17	2		1	
NP18	2		1	
NP19	2		1	
NP20	2		1	
NP21	2		1	
NP22	2		1	
NP23	2		1	
NP24	2		1	
NP25	2		1	
NP26	2		1	
NP27	2		1	
NP28	2		1	
NP29	2		1	
NP30	2		1	
NP31	2		1	
NP32	2			1
NP33	2		1	
NP34	2		1	
NP35	2		1	
NP36	2		1	
NP37	2		1	
NP38	2		1	
NP39	2		1	
NP40	2		1	
NP41	2		1	
NP42	2		1	
NP43	2		1	
NP44	2		1	
NP45	2		1	
NP46	2		1	
NP47	2		1	
NP48	2		1	
Total:	94	2	47	1
%:	65%	1%	33%	1%
%:	98%		2%	
% for each d.:	98%	2%	98%	2%

Test 2 (LV)

	/**eɪ**/–/aɪ/ Question nr. 9, 27		/**aɪ**/–/eɪ/ Question nr. 18	
	/**eɪ**/ (cor.)	/aɪ/ (incor.)	/**aɪ**/ (cor.)	/eɪ/ (incor.)
LP1	2		1	
LP2	2		1	
LP3	2		1	
LP4	2		1	
LP5	2		1	
LP6	2		1	
LP7	1	1		1
LP8	1	1	1	
LP9	2		1	
LP10	2		1	
LP11	2		1	
LP12	2		1	
LP13	2		1	
LP14	2		1	
LP15	1	1	1	
LP16	2		1	
LP17	2		1	
LP18	1	1	1	
LP19	1	1	1	
LP20	2		1	
LP21	2		1	
LP22	2		1	
LP23	2		1	
LP24	2		1	
LP25	2		1	
LP26	1	1	1	
LP27	2		1	
LP28				
LP29	2		1	
LP30	2		1	
Total:	52	6	28	1
%:	60%	7%	32%	1%
%:	92%		8%	
% for each d.:	90%	10%	97%	3%

Appendix 10, **Figures of part 3**

Test 3 (NO)

	/ɪ/–/e/ Question nr. 10		/e/–/ɪ/ Question nr. 1	
	/ɪ/ (cor.)	/e/ (incor.)	/e/ (cor.)	/ɪ/ (incor.)
NP1	1		1	
NP2	1		1	
NP3	1		1	
NP4	1		1	
NP5	1		1	
NP6	1		1	
NP7	1		1	
NP8	1		1	
NP9	1		1	
NP10	1		1	
NP11	1		1	
NP12	1		1	
NP13	1		1	
NP14	1		1	
NP15	1		1	
NP16	1		1	
NP17	1		1	
NP18	1		1	
NP19	1		1	
NP20	1		1	
NP21	1		1	
NP22	1		1	
NP23	1		1	
NP24	1		1	
NP25	1		1	
NP26	1		1	
NP27	1		1	
NP28	1		1	
NP29	1		1	
NP30	1		1	
NP31	1		1	
NP32	1		1	
NP33	1		1	
NP34	1		1	
NP35	1		1	
NP36	1			1
NP37	1		1	
NP38	1		1	
NP39	1		1	
NP40	1		1	
NP41	1		1	
NP42	1		1	
NP43	1		1	
NP44	1		1	
NP45	1		1	
NP46	1		1	
NP47	1		1	
NP48	1		1	
Total:	48	0	47	1
%:	50%	0%	49%	1%
%:	99%		1%	
% for each d.:	100%	0%	98%	2%

Test 3 (LV)

	/ɪ/–/e/ Question nr. 10		/e/–/ɪ/ Question nr. 1	
	/ɪ/ (cor.)	/e/ (incor.)	/e/ (cor.)	/ɪ/ (incor.)
LP1	1		1	
LP2	1		1	
LP3	1		1	
LP4	1		1	
LP5	1		1	
LP6	1		1	
LP7		1	1	
LP8	1		1	
LP9	1		1	
LP10	1		1	
LP11	1		1	
LP12	1		1	
LP13	1		1	
LP14	1		1	
LP15	1		1	
LP16	1		1	
LP17	1		1	
LP18	1		1	
LP19	1		1	
LP20	1		1	
LP21	1		1	
LP22	1		1	
LP23	1		1	
LP24	1		1	
LP25	1		1	
LP26	1		1	
LP27	1		1	
LP28	1		1	
LP29	1		1	
LP30	1		1	
Total:	29	1	30	0
%:	48%	2%	50%	0%
%:	98%		2%	
% for each d.:	97%	3%	100%	0%

Test 3 (NO)

	/**æ**/–/e/ Question nr. 2		/**e**/–/æ/ Question nr. 11	
	/**æ**/ (cor.)	/e/ (incor.)	/**e**/ (cor.)	/æ/ (incor.)
NP1	1		1	
NP2	1		1	
NP3	1		1	
NP4	1		1	
NP5	1		1	
NP6	1		1	
NP7	1		1	
NP8	1		1	
NP9	1		1	
NP10	1		1	
NP11	1		1	
NP12	1		1	
NP13	1		1	
NP14	1		1	
NP15	1		1	
NP16	1		1	
NP17	1		1	
NP18	1		1	
NP19	1		1	
NP20	1		1	
NP21	1		1	
NP22	1		1	
NP23	1		1	
NP24	1		1	
NP25	1		1	
NP26	1		1	
NP27	1		1	
NP28	1		1	
NP29	1		1	
NP30	1		1	
NP31	1		1	
NP32	1		1	
NP33	1		1	
NP34	1		1	
NP35	1		1	
NP36	1		1	
NP37	1		1	
NP38	1		1	
NP39	1		1	
NP40	1		1	
NP41	1		1	
NP42	1		1	
NP43	1		1	
NP44	1		1	
NP45	1		1	
NP46	1		1	
NP47	1		1	
NP48	1		1	
Total:	48	0	48	0
%:	50%	0%	50%	0%
%:	100%		0%	
% for each direction:	100%	0%	100%	0%

Test 3 (LV)

	/**æ**/–/e/ Question nr. 2		/**e**/–/æ/ Question nr. 11	
	/**æ**/ (cor.)	/e/ (incor.)	/**e**/ (cor.)	/æ/ (incor.)
LP1	1		1	
LP2	1		1	
LP3	1		1	
LP4		1	1	
LP5	1		1	
LP6	1		1	
LP7	1		1	
LP8	1		1	
LP9	1		1	
LP10	1		1	
LP11	1		1	
LP12	1			1
LP13	1		1	
LP14	1		1	
LP15	1		1	
LP16	1		1	
LP17	1		1	
LP18	1		1	
LP19	1		1	
LP20	1		1	
LP21	1		1	
LP22	1		1	
LP23	1			1
LP24	1		1	
LP25	1		1	
LP26	1		1	
LP27	1		1	
LP28	1		1	
LP29	1		1	
LP30	1		1	
Total:	29	1	28	2
%:	48%	2%	47%	3%
%:	95%		5%	
% for each d.:	97%	3%	93%	7%

Test 3 (NO)

	/æ/–/ʌ/		/ʌ/–/æ/	
	Question nr. 12		Question nr. 3	
	/æ/ (cor.)	/ʌ/ (incor.)	/ʌ/ (cor.)	/æ/ (incor.)
NP1	1		1	
NP2	1		1	
NP3	1		1	
NP4	1		1	
NP5	1		1	
NP6	1		1	
NP7	1		1	
NP8		1	1	
NP9	1		1	
NP10	1		1	
NP11	1		1	
NP12	1			1
NP13	1		1	
NP14	1		1	
NP15	1		1	
NP16	1		1	
NP17	1		1	
NP18	1		1	
NP19	1		1	
NP20	1		1	
NP21	1		1	
NP22	1		1	
NP23	1		1	
NP24	1		1	
NP25	1		1	
NP26	1		1	
NP27	1		1	
NP28	1		1	
NP29	1		1	
NP30	1		1	
NP31	1		1	
NP32	1		1	
NP33	1		1	
NP34	1		1	
NP35	1		1	
NP36	1		1	
NP37	1		1	
NP38	1		1	
NP39	1		1	
NP40	1		1	
NP41	1		1	
NP42	1		1	
NP43	1		1	
NP44	1		1	
NP45	1		1	
NP46	1		1	
NP47	1		1	
NP48	1		1	
Total:	47	1	47	1
%:	49%	1%	49%	1%
%:	98%		2%	
% for each direction:	98%	2%	98%	2%

Test 3 (LV)

	/æ/–/ʌ/		/ʌ/–/æ/	
	Question nr. 12		Question nr. 3	
	/æ/ (cor.)	/ʌ/ (incor.)	/ʌ/ (cor.)	/æ/ (incor.)
LP1	1			1
LP2	1		1	
LP3		1	1	
LP4		1	1	
LP5	1		1	
LP6	1		1	
LP7	1		1	
LP8		1	1	
LP9	1		1	
LP10	1			1
LP11	1		1	
LP12	1			1
LP13		1	1	
LP14	1		1	
LP15	1		1	
LP16	1			1
LP17	1		1	
LP18	1		1	
LP19		1	1	
LP20		1		1
LP21	1		1	
LP22	1		1	
LP23	1			1
LP24	1		1	
LP25	1		1	
LP26		1	1	
LP27	1			1
LP28	1		1	
LP29	1		1	
LP30	1		1	
Total:	23	7	23	7
%:	38%	12%	38%	12%
%	76%		24%	
% for each d.:	77%	23%	77%	23%

Test 3 (NO)

	/ɒ/–/ʌ/		/ʌ/–/ɒ/	
	Question nr. 4		Question nr. 13	
	/ɒ/ (cor.)	/ʌ/ (incor.)	/ʌ/ (cor.)	/ɒ/ (incor.)
NP1	1			1
NP2	1		1	
NP3	1			1
NP4	1			1
NP5	1		1	
NP6	1			1
NP7	1		1	
NP8	1		1	
NP9	1		1	
NP10	1			1
NP11		1		1
NP12	1			1
NP13	1			1
NP14	1			1
NP15	1		1	
NP16	1			1
NP17	1		1	
NP18	1		1	
NP19	1			1
NP20	1			1
NP21	1			1
NP22	1			1
NP23	1		1	
NP24	1		1	
NP25	1			1
NP26	1			1
NP27	1		1	
NP28	1			1
NP29	1		1	
NP30	1			1
NP31	1			1
NP32	1			1
NP33	1		1	
NP34	1		1	
NP35		1		1
NP36	1		1	
NP37	1		1	
NP38	1			1
NP39	1		1	
NP40	1		1	
NP41	1		1	
NP42	1		1	
NP43	1			1
NP44	1		1	
NP45	1		1	
NP46	1		1	
NP47	1		1	
NP48	1		1	
Total:	46	2	25	23
%:	48%	2%	26%	24%
%:	74%		26%	
% for each direction:	96%	4%	52%	48%

Test 3 (LV)

	/ɒ/–/ʌ/		/ʌ/–/ɒ/	
	Question nr. 4		Question nr. 13	
	/ɒ/ (cor.)	/ʌ/ (incor.)	/ʌ/ (cor.)	/ɒ/ (incor.)
LP1	1			1
LP2	1		1	
LP3	1			1
LP4	1		1	
LP5	1		1	
LP6	1			1
LP7		1		1
LP8	1			1
LP9	1			1
LP10	1			1
LP11	1		1	
LP12	1		1	
LP13	1		1	
LP14		1	1	
LP15		1	1	
LP16		1	1	
LP17	1		1	
LP18	1			1
LP19		1	1	
LP20	1			1
LP21	1			1
LP22		1	1	
LP23	1			1
LP24		1	1	
LP25		1		1
LP26		1		1
LP27	1		1	
LP28	1			1
LP29	1			1
LP30		1	1	
Total:	20	10	15	15
%:	33%	17%	25%	25%
%	58%		42%	
% for each d.:	67%	33%	50%	50%

Test 3 (NO)

	/ɪ/–/ə/		/ə/–/ɪ/	
	Question nr. 14		Question nr. 5	
	/ɪ/ (cor.)	/ə/ (incor.)	/ə/ (cor.)	/ɪ/ (incor.)
NP1	1			1
NP2	1			1
NP3	1			1
NP4	1		1	
NP5	1			1
NP6	1		1	
NP7	1		1	
NP8	1		1	
NP9	1		1	
NP10	1		1	
NP11	1		1	
NP12	1			1
NP13	1		1	
NP14	1		1	
NP15	1			1
NP16	1		1	
NP17	1		1	
NP18	1			1
NP19	1		1	
NP20	1			1
NP21	1			1
NP22	1			1
NP23	1		1	
NP24	1			1
NP25	1		1	
NP26	1			1
NP27	1		1	
NP28	1		1	
NP29	1		1	
NP30	1		1	
NP31	1		1	
NP32	1		1	
NP33	1		1	
NP34	1			1
NP35	1		1	
NP36	1			1
NP37	1			1
NP38	1			1
NP39	1			1
NP40	1		1	
NP41	1			1
NP42	1		1	
NP43	1		1	
NP44	1			1
NP45	1		1	
NP46		1	1	
NP47	1			1
NP48	1		1	
Total:	47	1	28	20
%:	49%	1%	29%	21%
%:	78%		22%	
% for each direcion:	98%	2%	58%	42%

Test 3 (LV)

	/ɪ/–/ə/		/ə/–/ɪ/	
	Question nr. 14		Question nr. 5	
	/ɪ/ (cor.)	/ə/ (incor.)	/ə/ (cor.)	/ɪ/ (incor.)
LP1	1			1
LP2	1		1	
LP3	1			1
LP4	1		1	
LP5	1		1	
LP6	1			1
LP7	1		1	
LP8		1		1
LP9		1	1	
LP10	1			1
LP11	1			1
LP12	1			1
LP13	1		1	
LP14		1		1
LP15		1		1
LP16	1		1	
LP17	1			1
LP18	1			1
LP19	1			1
LP20	1		1	
LP21	1		1	
LP22	1			1
LP23	1		1	
LP24	1		1	
LP25	1			1
LP26	1		1	
LP27	1		1	
LP28	1		1	
LP29	1		1	
LP30	1		1	
Total:	26	4	16	14
%:	43%	7%	27%	23%
%:	70%		30%	
% for each d.:	87%	13%	53%	47%

Test 3 (NO)

	/**u:**/–/ɔ:/ Question nr. 6		/**ɔ:**/–/u:/ Question nr. 15	
	/**u:**/ (cor.)	/ɔ:/ (incor.)	/**ɔ:**/ (cor.)	/u:/ (incor.)
NP1	1		1	
NP2	1		1	
NP3	1		1	
NP4	1		1	
NP5	1		1	
NP6	1		1	
NP7	1		1	
NP8	1		1	
NP9	1		1	
NP10	1		1	
NP11	1		1	
NP12	1		1	
NP13	1		1	
NP14	1		1	
NP15	1		1	
NP16	1		1	
NP17	1		1	
NP18	1		1	
NP19	1		1	
NP20	1		1	
NP21	1		1	
NP22	1		1	
NP23	1		1	
NP24	1		1	
NP25	1		1	
NP26	1		1	
NP27	1		1	
NP28	1		1	
NP29	1		1	
NP30	1		1	
NP31	1		1	
NP32	1		1	
NP33	1		1	
NP34	1		1	
NP35	1		1	
NP36	1		1	
NP37	1		1	
NP38	1		1	
NP39	1		1	
NP40	1		1	
NP41	1		1	
NP42	1		1	
NP43	1		1	
NP44	1		1	
NP45	1		1	
NP46	1		1	
NP47	1		1	
NP48	1		1	
Total:	48	0	48	0
%:	50%	0%	50%	0%
%:	100%		0%	
% for each direction:	100%	0%	100%	0%

Test 3 (LV)

	/**u:**/–/ɔ:/ Question nr. 6		/**ɔ:**/–/u:/ Question nr. 15	
	/**u:**/ (cor.)	/ɔ:/ (incor.)	/**ɔ:**/ (cor.)	/u:/ (incor.)
LP1	1		1	
LP2	1		1	
LP3	1		1	
LP4	1		1	
LP5	1		1	
LP6	1		1	
LP7	1		1	
LP8	1		1	
LP9	1		1	
LP10	1		1	
LP11	1		1	
LP12	1		1	
LP13	1		1	
LP14	1		1	
LP15	1			1
LP16	1		1	
LP17	1		1	
LP18	1		1	
LP19	1		1	
LP20	1		1	
LP21	1		1	
LP22	1		1	
LP23	1		1	
LP24	1		1	
LP25	1		1	
LP26	1		1	
LP27	1		1	
LP28	1		1	
LP29	1			1
LP30	1		1	
Total:	30	0	28	2
%:	50%	0%	47%	3%
%:	97%		3%	
% for each d.:	1	0	93%	7%

Test 3 (NO)

	/ɪə/–/eə/		/eə/–/ɪə/	
	Question nr. 7		Question nr. 16	
	/ɪə/ (cor.)	/eə/ (incor.)	/eə/ (cor.)	/ɪə/ (incor.)
NP1	1		1	
NP2		1	1	
NP3		1	1	
NP4		1	1	
NP5		1	1	
NP6		1	1	
NP7	1		1	
NP8		1	1	
NP9	1		1	
NP10		1	1	
NP11	1		1	
NP12		1	1	
NP13		1	1	
NP14		1	1	
NP15		1	1	
NP16	1		1	
NP17		1	1	
NP18		1	1	
NP19		1	1	
NP20		1	1	
NP21	1		1	
NP22		1	1	
NP23		1	1	
NP24		1	1	
NP25		1	1	
NP26		1	1	
NP27		1	1	
NP28		1	1	
NP29		1	1	
NP30		1	1	
NP31		1	1	
NP32		1	1	
NP33		1	1	
NP34		1	1	
NP35		1	1	
NP36	1		1	
NP37	1		1	
NP38	1		1	
NP39		1	1	
NP40	1		1	
NP41		1	1	
NP42		1	1	
NP43	1		1	
NP44		1	1	
NP45	1		1	
NP46	1		1	
NP47		1	1	
NP48	1		1	
Total:	14	34	48	0
%:	15%	35%	50%	0%
%:	65%		35%	
% for each direction:	29%	71%	100%	0%

Test 3 (LV)

	/ɪə/–/eə/		/eə/–/ɪə/	
	Question nr. 7		Question nr. 16	
	/ɪə/ (cor.)	/eə/ (incor.)	/eə/ (cor.)	/ɪə/ (incor.)
LP1		1	1	
LP2	1		1	
LP3	1		1	
LP4		1	1	
LP5		1	1	
LP6		1	1	
LP7		1		1
LP8		1	1	
LP9		1	1	
LP10	1		1	
LP11	1		1	
LP12	1		1	
LP13		1	1	
LP14		1	1	
LP15		1	1	
LP16		1	1	
LP17		1	1	
LP18		1	1	
LP19	1		1	
LP20		1		1
LP21	1		1	
LP22		1	1	
LP23	1		1	
LP24		1	1	
LP25		1	1	
LP26		1	1	
LP27	1		1	
LP28		1		1
LP29	1		1	
LP30		1	1	
Total:	10	20	27	3
%:	17%	33%	45%	5%
%:	62%		38%	
% for each d.:	33%	67%	90%	10%

Test 3 (NO)

	/**əʊ**/–/aʊ/		/**aʊ**/–/əʊ/	
	Question nr. 17		Question nr. 8	
	/**əʊ**/ (cor.)	/aʊ/ (incor.)	/**aʊ**/ (cor.)	/əʊ/ (incor.)
NP1	1		1	
NP2	1		1	
NP3	1		1	
NP4	1		1	
NP5	1		1	
NP6	1		1	
NP7	1		1	
NP8	1		1	
NP9	1		1	
NP10	1		1	
NP11	1		1	
NP12		1	1	
NP13	1		1	
NP14	1		1	
NP15	1		1	
NP16		1	1	
NP17		1	1	
NP18	1		1	
NP19	1		1	
NP20	1		1	
NP21	1		1	
NP22	1		1	
NP23	1		1	
NP24	1		1	
NP25	1		1	
NP26	1		1	
NP27	1		1	
NP28	1		1	
NP29	1		1	
NP30	1		1	
NP31	1		1	
NP32	1		1	
NP33		1	1	
NP34	1		1	
NP35	1		1	
NP36	1		1	
NP37	1		1	
NP38	1		1	
NP39		1	1	
NP40		1	1	
NP41	1		1	
NP42	1		1	
NP43	1		1	
NP44	1		1	
NP45	1		1	
NP46	1		1	
NP47		1	1	
NP48	1		1	
Total:	41	7	48	0
%:	43%	7%	50%	0%
%:	93%		7%	
% for each direction:	85%	15%	100%	0%

Test 3 (LV)

	/**əʊ**/–/aʊ/		/**aʊ**/–/əʊ/	
	Question nr. 17		Question nr. 8	
	/**əʊ**/ (cor.)	/aʊ/ (incor.)	/**aʊ**/ (cor.)	/əʊ/ (incor.)
LP1		1	1	
LP2		1	1	
LP3	1		1	
LP4		1	1	
LP5		1	1	
LP6		1	1	
LP7	1		1	
LP8	1		1	
LP9		1	1	
LP10		1	1	
LP11	1		1	
LP12		1	1	
LP13		1	1	
LP14		1	1	
LP15		1	1	
LP16	1		1	
LP17	1		1	
LP18	1		1	
LP19		1		1
LP20		1	1	
LP21	1		1	
LP22	1		1	
LP23		1		1
LP24	1		1	
LP25		1	1	
LP26		1	1	
LP27		1	1	
LP28		1	1	
LP29		1	1	
LP30	1		1	
Total:	11	19	28	2
%:	18%	32%	47%	3%
%:	65%		35%	
% for each d.:	37%	63%	93%	7%

Test 3 (NO)

	/**eɪ**/–/aɪ/		/**aɪ**/–/eɪ/	
	Question nr. 9		Question nr. 18	
	/**eɪ**/ (cor.)	/aɪ/ (incor.)	/**aɪ**/ (cor.)	/eɪ/ (incor.)
NP1	1		1	
NP2	1		1	
NP3	1		1	
NP4	1		1	
NP5	1		1	
NP6	1		1	
NP7	1		1	
NP8	1		1	
NP9	1		1	
NP10	1		1	
NP11	1		1	
NP12	1		1	
NP13	1			1
NP14	1		1	
NP15	1		1	
NP16	1		1	
NP17	1		1	
NP18	1		1	
NP19	1		1	
NP20	1		1	
NP21	1		1	
NP22	1		1	
NP23	1		1	
NP24	1		1	
NP25	1		1	
NP26	1		1	
NP27	1		1	
NP28	1		1	
NP29	1		1	
NP30	1		1	
NP31	1		1	
NP32	1		1	
NP33	1		1	
NP34	1		1	
NP35	1		1	
NP36	1		1	
NP37	1		1	
NP38	1		1	
NP39	1		1	
NP40	1		1	
NP41	1		1	
NP42	1		1	
NP43	1		1	
NP44	1		1	
NP45	1		1	
NP46	1		1	
NP47	1		1	
NP48	1		1	
Total:	48	0	47	1
%:	50%	0%	49%	1%
%	99%		1%	
% for each direction:	100%	0%	98%	2%

Test 3 (LV)

	/**eɪ**/–/aɪ/		/**aɪ**/–/eɪ/	
	Question nr. 9		Question nr. 18	
	/**eɪ**/ (cor.)	/aɪ/ (incor.)	/**aɪ**/ (cor.)	/eɪ/ (incor.)
LP1	1		1	
LP2	1		1	
LP3	1		1	
LP4	1		1	
LP5	1		1	
LP6	1		1	
LP7	1			1
LP8	1		1	
LP9	1		1	
LP10	1		1	
LP11	1		1	
LP12	1		1	
LP13	1		1	
LP14	1		1	
LP15	1		1	
LP16	1		1	
LP17	1		1	
LP18	1		1	
LP19	1		1	
LP20	1		1	
LP21	1		1	
LP22	1		1	
LP23	1			1
LP24	1		1	
LP25	1		1	
LP26	1		1	
LP27	1		1	
LP28	1		1	
LP29	1		1	
LP30	1		1	
Total:	30	0	28	2
%:	50%	0%	47%	3%
%:	97%		3%	
% for each d.:	100%	0%	93%	7%

Appendix 11

The recording of the test

The test was recorded by Gjertrud F. Stenbrenden at the University of Oslo in February 2012